THE

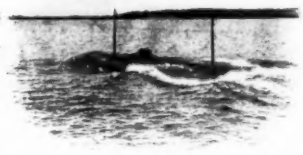
ENGINEERING MAGAZINE

VOL. XIX. JUNE, 1900. No. 3.

THE DEMONSTRATED SUCCESS OF THE SUBMARINE BOAT.

By Rear Admiral Philip Hichborn, Chief Constructor, U. S. Navy.

MY attention was first drawn to the question of the practical utility of submarine boats by the findings of the so-called "Endicott Board" in 1886. This Board was constituted under the Act of Congress of March 3, 1885, and was composed of prominent Army and Navy officers and civilians, with the Secretary of War as President, and was known under the act authorizing it as the "Board on Fortifications and Other Defenses." Its report was printed as Ex. Doc. 46 of the Forty-ninth Congress, last session, and in it, while the Board as a whole expressed the opinion that "Submarine boats have not passed the experimental stage and the Board has at present no recommendation to make in their regard," there appeared as an appendix to a report of a sub-committee—of which Col. Abbott of the engineers, and Commander, now Admiral, Sampson were members—a very exhaustive and complete history of the development of submarines.



The perfection of the submarine boat has a double interest—as a triumph in the adaptation of mechanical transport, and as a revolutionizing influence in naval tactics and strategy. France is keenly interested, Germany is investigating. England seems to be waiting developments in other navies. Admiral Hichborn, the leading American authority, tells what the United States have done. THE ENGINEERING MAGAZINE is happy in presenting his admirable review and analysis. It is a complete and authoritative summary of past work and present conditions.—THE EDITORS.

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Edward Everett Hale tells us that:

"Boards are long and narrow,
They are made of wood";

and while the reverend gentleman's definition is quite exact if judged by the occasional results of the work of Boards, it must be remembered that these results are oftener due to hampering conditions than to woodenness of individual members.

It is certain that the members of the Endicott Board were neither narrow nor wooden, and that its report was most judicious and valuable, although its recommendations in regard to mobile defenses received but little attention from Congress.

To one accustomed to the actions of Boards and to reading between the lines of a report, it was apparent that Gen. Abbott and Admiral Sampson desired to accentuate the probable value of submarines, although the Board as a whole could only be brought to an expression in regard to them which was the merest platitude. This desire was shown by the facts that the appendix on submarines was written by Capt. Maguire, Secretary to the Board; that the body of the report accentuates the necessity for securing an economic mobile defense of the coast; that the estimates and designs for coast-defense ships were unsatisfactory; and that no satisfactory method of securing the coasts without the aid of submarines was found, although the Board was emphatic in its decision that sea-going ships of the Navy should "act offensively and not be confined to the defense of ports."

The enormous stretch of our coasts, with their numerous attractive points for attack for an enemy, were described, and surface torpedo boats were recommended for their defense. Now it is clear that the providing of surface torpedo boats alone would furnish only a very unsatisfactory defense, since they can only hope for success under cover of darkness, and that the idea of providing enough armored ships for the local defense of the more important ports and important strategic points was impracticable on account of expense, even if the proper offensive use of the fleet were to be abandoned and it were degraded to local coast defense work. What then could be our resort?

Evidently the answer in the report of Gen. Abbott and Admiral Sampson was intended to be: "Possibly submarines."

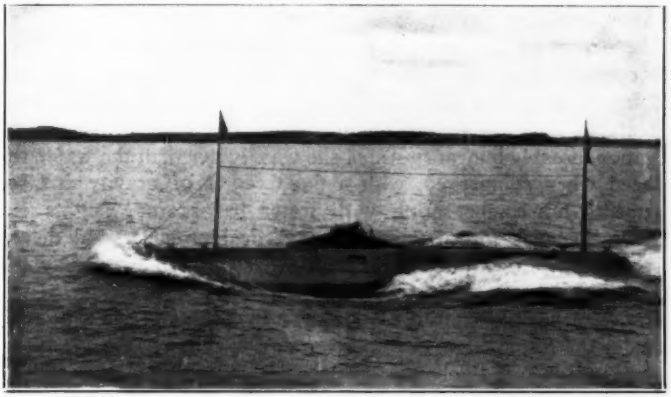
Naturally this matter interested me, and I investigated the history and development of the type, using the Board's study as a basis.

It appears that the art of brain-directed submarine navigation has been in process of development for at least three hundred years, and that many of the attempts to make it practicable would have been near

enough to success to insure continued and logical effort in improvement, had it not been for the ultra-conservatism of seafaring folk. Curiously enough, automatic submarine navigation has had but a few decades of development, has met with but little obstruction from seamen, and has rapidly advanced to the high state of perfection that is shown in the automobile torpedoes of the present day.

A glance at the history of submarine boats is necessary in order to trace the course of development.

William Bourne, an Englishman, has the credit of operating the first submarine boat, as such, in contradistinction to a diving bell; but



THE HOLLAND SUBMARINE BOAT RUNNING ON THE SURFACE.
This is the boat recently accepted by the United States Navy.

the records of his operations have been lost in the years since his work was done, rather more than three hundred years ago.

In 1624, the Hollander, Cornelius Van Drebbel, took twelve persons for an under-water run in his submarine boat worked by twelve pairs of sculls and carried "quintessence of air" for them to breathe—probably what we now call compressed air.

During the succeeding twenty years the history of submarine navigation was worked out, the main principles well grasped, and in 1653 a Frenchman, name unknown, built and operated a submarine boat at Rotterdam. Later in the century an Englishman named Day built and operated a submarine boat and is reported to have lost his life in her upon his second submerged run, through the crushing of the hull under pressure due to depth of water. I am inclined to think that the accident was a real one and that its deterrent effect accounts for the

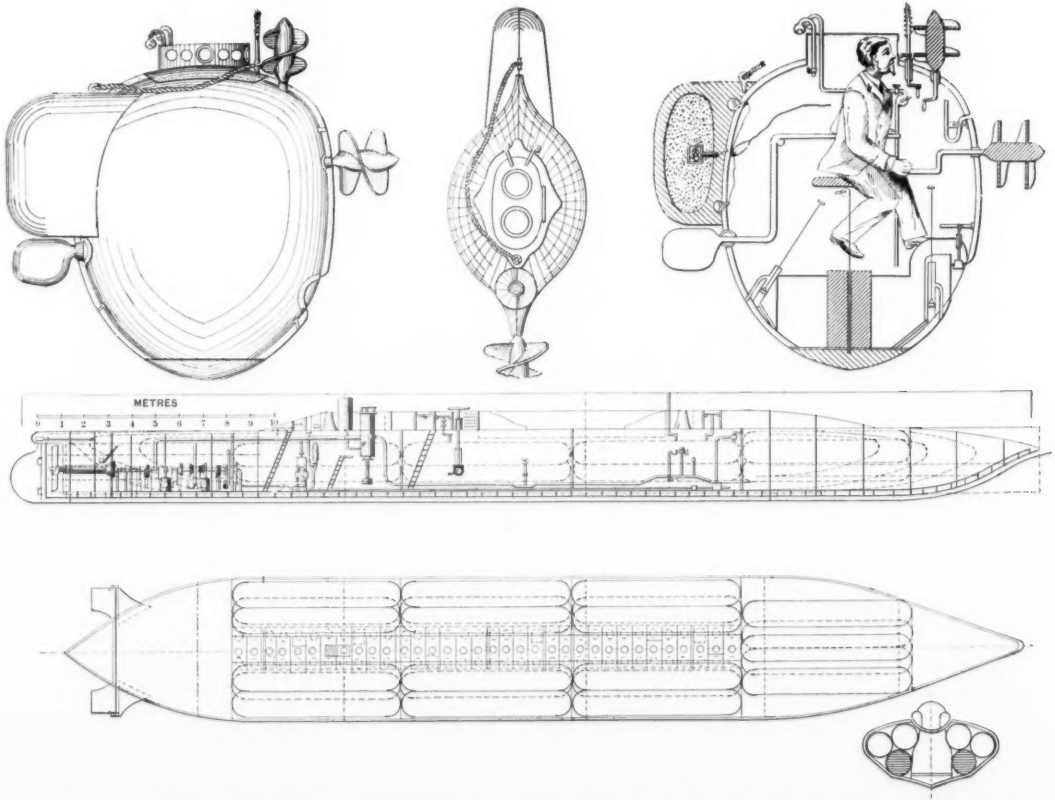
long hiatus in submarine-boat attempts that existed between the time of Day and that of the inception of Bushnell's boat in 1771.

If Day were really crushed in his boat, he has the unique distinction of being the only known victim of the dangers of submarine navigation, but this distinction depends upon the supposition that reports of submarine accidents were much more reliable two hundred and forty years ago than they have been for the last forty years, during which period there have been *authentic* newspaper reports of the loss of eighty-two lives in attempting submarine navigation in the United States. Fifty of these lives were not lost at all, and the other thirty-two, though lost in a boat designed to operate as a submarine, were all lost when, and apparently because, she was not so operating.

The design of Bushnell, of Connecticut, projected in 1771 and made operative in 1775, was for a small one-man-operated boat devised for work against ships at anchor. The boat possessed many of the features that are recognized to-day as essential for submarine navigation, notably buoyancy—*i. e.*, she was lighter than the water she displaced when submerged, with a fixed center of gravity and arrangements for compensating with water ballast for weights expended. She was forced under by a vertical propeller and driven forward by a horizontal one—both worked through cranks by the crew of one.

Her efficiency for the times was shown by Sergeant Lee, who took her under the Eagle frigate near Governor's Island, and who failed to secure his torpedo to the bottom of the ship because he forgot to make use of a detachable weight fitted for an anchor. This efficiency seemed to impress our forefathers—as evidences of greater efficiency fail to impress us of a later day—for more than twenty years after the failure to blow up the Eagle we find Washington writing to Jefferson and expressing the opinion that the submarine navigation was successful and that the lack of results was due to difficulty in finding men with sufficient brains and bravery to work the boat.

A dozen years after Washington wrote this letter, Fulton, in 1797, was pushing submarine navigation in France, for it must be remembered that he was a submarine-boat man before he took to steam-boating. Borrowing the ideas of Bushnell and applying them to more powerful craft, he made a long stride in the methods of under-water work. Ninety-eight years ago Fulton turned out his second twin-screw hand-worked submarine boat, made a submerged run of four hours and twenty minutes, placed a torpedo under a hulk and blew it up—and received the regular encouragement served out to people who are ahead of their time—obstruction tempered with neglect.



THE UPPER THREE FIGURES REPRESENT BUSHNELL'S SUBMARINE BOAT; THE LOWER ONES SHOW PLAN AND SECTION OF THE BRUN BOAT, "LE PLONGEUR," TESTED UNDER ADMIRAL BOURGOIS.

For nearly thirty years and until the day of his death—which must have brought with it a great sense of relief to the naval obstructionists of the day—Fulton was an ardent submarine man and his "Nautilus" was, for her time, as efficient as the "Holland" of to-day—and met with the same kind of encouragement.

To the credit of that wonderful man, Napoleon I., it must in justice be said that he appreciated what submarines meant, just as he appreciated breech-loading small arms. In both cases he submitted the designs to Boards, and in both cases the devices were condemned because the Boards were long, narrow, and wooden, and consequently failed to see the points in breech-loaders which were not recognized for fifty years and the points in submarine navigation which are not yet acknowledged. A curious illustration of the conservatism of naval opinion was given in a trial by Fulton of the effectiveness of torpedoes. He was to attack a U. S. ship and the Commander, Commodore Rogers, was to defend it. The Commodore rigged booms around his vessel so that he destroyed her mobility and usefulness as a fighting ship. He successfully defended his vessel, and instead of the result being looked upon as a triumph for the torpedo, since the defense nullified the fighting efficiency of the ship, it was hailed as a triumph of the ship, since the torpedo could not blow her up.

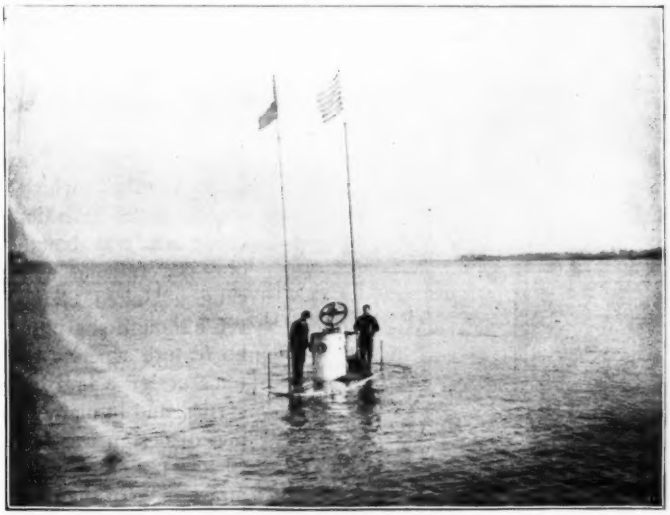
But the French did not wholly abandon the submarine idea. In 1810 a committee of the Institute reported, after trials of the Coessin boat, that "there is no longer any doubt that submarine navigation may be established very expeditiously and at very little cost."

From 1810 to the time of the United States civil war submarine boats were designed every few years, nearly all of them driven by manual power and most of them following the ideas of Bushnell in forcing them down by an application of power apart from the diving rudder. During the civil war both the Federal and Confederate Governments tried to develop submarines, and failed of success only because the "state of the art" was not studied, and crude devices were tried. The U. S. boat was a failure in her propulsion—an absurd arrangement of duck-foot hand-worked paddles in an age when the screw propeller was in common use—and the Confederate boat, although she succeeded in sinking the "Housatonic," was a failure as a submarine boat and a death trap to her crews, because she was not worked as a submarine, but as a low-freeboard surface torpedo boat, for which purpose she was never designed and for which she proved dangerous and inefficient.

In 1863 the Brun boat, the "Plongeur," was built at Rochefort,

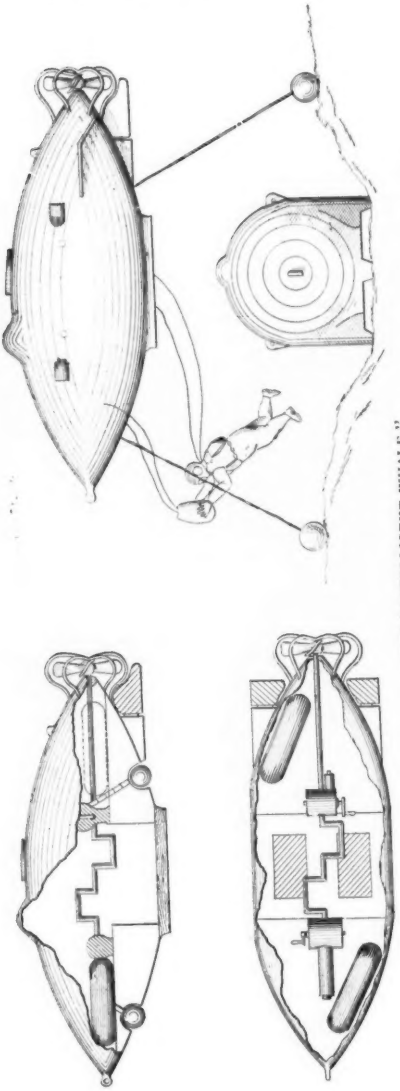
France, and was one of the first to have mechanical motive power. In this case the power consisted of an 80 horse-power compressed-air engine. The boat herself was 146 feet long and about 12 feet in diameter—was, in fact, rather an ambitious attempt at a submarine boat. But the idea of *steering* a buoyant body under the surface had not arrived and she was made to sink by taking in water ballast until she was of the same specific gravity as water. In her first trials under Admiral Bourgois she had no diving rudders and was supposed to attain a desired depth solely by varying her weight. The natural consequence was that when she was made the same weight as water there was no control in the vertical plane. If she happened to be down by the head, her propulsion drove her down to the bottom, on which she carromed and bounced up and down between the bottom and the surface in her onward course. This defect was remedied later by fitting horizontal rudders, when she worked very well—with the usual result that she was declared useless by a Board, and made into a water tank.

The striking illustration of the need of horizontal rudders furnished by the "Plongeur" was little heeded abroad, and even in France the importance of the fact demonstrated was not grasped because the boat was at first designed to move in the vertical plane by varying her weight. One of the most curious circumstances connected with the development of submarine navigation is that in very few cases does



THE "ARGONAUT" ON THE SURFACE.

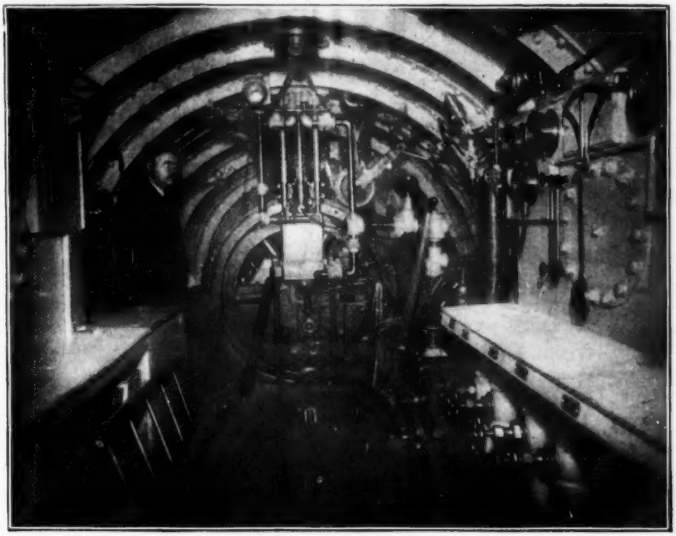
one find evidences of the study of the state of the art. The idea of attempting to move in water in three dimensions instead of in the usual two seems to have appealed to almost every submarine inventor as something so mysterious that no one could ever before have thought it out, and therefore almost all of them began *de novo,* with the consequence that our late patent files show designs for attaining results that had been reached a couple of centuries ago.



THE "INTELLIGENT WHALE."

During the last forty years attempts to solve the problem of submarine navigation have been almost constant and the progress has been generally forward, although often indirect and sometimes retrograde, and these years may be considered the era of the power-driven boats. One of the last hand-worked submarine craft was the "Intelligent Whale," which attracted much attention because she was bought by our government and became a United States vessel, although she possessed no feature superior to Fulton's design a half century earlier, and in many principles of design was inferior. She is remarkable only as an example of the power of conservatism which practi-

cally prevented her use for studying the laws of immersed bodies, which, on the one occasion she was operated after she became United States property, was responsible for manning her with an incompetent crew and trying her under ridiculous conditions, which worked up a great fright about the danger connected with her, and which led to the insistence that she should be hoisted out of water and be never again used. Within a few weeks there has appeared a press account of the loss of life in the "Intelligent Whale" with a total of forty-nine victims to her credit. As a matter of fact, no life has been lost in her or in any way connected with her, from the time she was built in Galveston, just after the close of the civil war, to the present day.



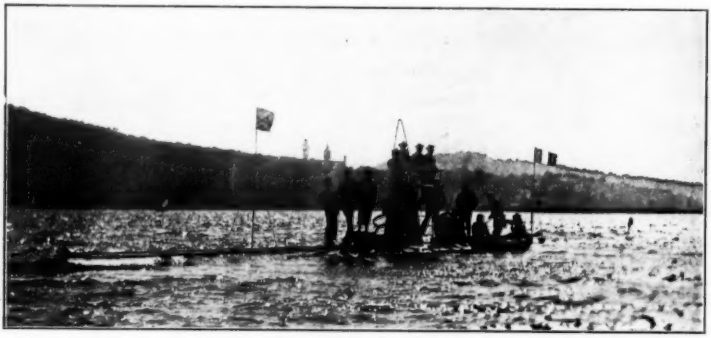
THE INTERIOR OF THE "ARGONAUT."

In 1877, Jno. P. Holland, of Paterson, N. J., built an experimental submarine boat in New York and made experiments with her on the Passaic at Paterson. She was the first submarine since Bushnell's time employing water ballast and always retaining buoyancy, in which provision was made to insure a fixed centre of gravity and a fixed absolute weight. Moreover, she was the first buoyant submarine to be steered down and up inclines in the vertical plane by horizontal-rudder action as she was pushed forward by her motor, instead of being pushed up and down by vertically-acting mechanism. Her petroleum engine, provided for motive power and for charging her compressed-

air flasks, was inefficient and the boat therefore failed as a practical craft; but in her were demonstrated all the chief principles of successful brain-directed submarine navigation. In 1881, Holland turned out a larger and better boat in which he led the world far and away in the solution of submarine problems, and for a couple of years demonstrated that he could perfectly control his craft in the vertical plane. Eventually, through financial complications, she was taken to New Haven, where she now is. Meantime Whitehead had grasped all the principles necessary for automatic submarine navigation, had received encouragement instead of obstruction, and had brought his boats—automobile torpedoes—to a high state of perfection. Indeed, they leaped to so high a pinnacle of popularity that the designs of men-of-war of the last decade were hampered and loaded down with inefficient torpedo installations.

Since 1880 submarine boats have been experimented with in nearly all European countries, and in France, Spain, and Italy the governments have encouraged the experiments. In France alone has there been government encouragement through a series of years; and although the development in that country has been intermittent as a favorable or unfavorable administration came into power, the progress has been so great as to call forth official estimates and requests for the building of a submarine flotilla of 38 boats. The French type developed by the trials with an electric-storage motor boat, the "Zedé," is a very good one, deficient to be sure in some very important details, but sufficiently good for the economical and methodical French to be impressed with the great economy that submarines will bring to their mobile coast defenses.

While Mr. Whitney was Secretary of the Navy he was anxious to



THE SUBMARINE "GUSTAV ZEDÉ."

LAKE'S SUBMARINE BOAT, THE "ARGONAUT."

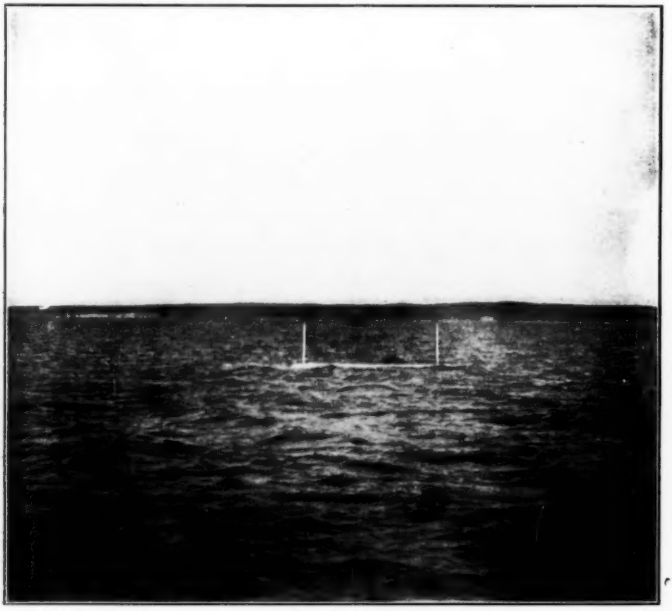
She is a "bottom worker," propelling herself by the wheels seen in the picture as well as by the screw. She has been particularly developed for commercial uses—wrecking, diving, and submarine construction—and is said to have traveled more than 1,000 miles under water along the United States coasts.

provide some kind of protection against gun fire for torpedo boats. and under suggestion he invited proposals for submarine boats. Several designs were offered and two propositions to build were made by the Cramps, the designs being those of Holland and Nordenfelt, the latter of whom had built five or more boats and had sold two to Greece and two to Turkey. The designs were most interesting for comparison, since they differed radically in the very important principle of control in the vertical plane.

Nordenfelt asserted that, in operating a boat under water, it was essential to keep her always on an even keel, and for this purpose he provided horizontal rudders, not for inclining her down and up, but placed in both bow and stern for the purpose of maintaining parallelism of the keel with the surface of the water. For submergence, he used vertically-acting propellers outside the hull in the plane of the midships section, and consequently the stored power was used to pull the boat vertically down against the resistance of her whole greatest longitudinal section and that of her reserve or normal buoyancy. As great longitudinal metacentric height as possible was given in the

design. In short, the boat was to be as stiff as possible as regards any inclination of the keel in the vertical plane.

The Holland design was diametrically opposite as regards submerged manœuvering. It provided for small longitudinal metacentric height, for stern horizontal rudder only, was to give as lively a movement as possible in the vertical plane by the action of the stern rudder alone, and was to attain submergence and rising by pushing the boat by her whole motive power down or up an incline, the angle of which was to be determined by the angle of the horizontal rudder. The Nordenfelt was a down-haul or sinking design, the Holland a *steering* under, or diving device. A dogma was issued by Mr. Nordenfelt to the effect that the keel must always be kept parallel to the surface of the water, and this dogma was accepted by many naval officers be-



THE HOLLAND BOAT RUNNING AWASH, BEFORE THE FIRST DIVE.

cause it was given out authoritatively, although it was never supported by theory, reasoning, or facts. The idea of rigidity in the vertical plane may have arisen from the fact that if the fixedness of the centre of gravity of a submarine boat be neglected she will be very likely to stand on her bow and rest on her stern upon occasion, as one of the

Nordenfelt boats is reported to have done in the Bosphorus, and the fact that Mr. Nordenfelt's patents on submarines covered down-haul devices and nothing else of importance may have had some weight in increasing the rigid-keel cult. Now it is apparent that the livelier a surface vessel is on her helm the more satisfactorily can she be navi-

MAKING THE FIRST DIVE ON THE HOLLAND.

gated in a narrow channel, especially when there must be frequent close approaches to either shore, and that under such conditions a vessel with slow turning power would be very awkward.

Submarine work for a torpedo boat is, in the vertical plane, confined to the very narrow channel, so to speak, between the surface and the seven-fathom mark, both of which must be frequently touched in coming up to see the position of the enemy and in going down to avoid gun fire and torpedoes. Both designs proposed steam as the motive power, to be used from a fired boiler while the boat was running on the surface, and from the same boiler with fires hauled as a steam store, or from a chemical heater, when running submerged, and both provided for retained buoyancy.

The Holland design was accepted because it embodied the ideas of a fixed centre of gravity, of an exact compensation for expended weights, of a low longitudinal metacentric height, and of quick diving and rising by the effort of the propeller pushing the vessel against the resistance of her midship section only, down or up inclines, the angles of which were to be determined by horizontal-rudder action. But difficulties in regard to guaranties of performance prevented the closing of a contract that year—1888—and the next year, after all

COMING UP FOR OBSERVATION.

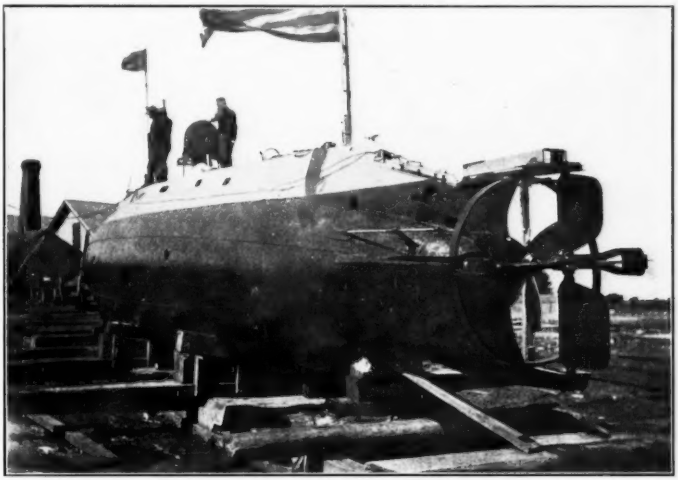
preliminaries were arranged, a change in administration caused the matter to be put aside.

Just before proposals were invited by the Navy Department the Tuck boat was built in New York. Her salient features were the form of her hull, which was that of a narrow-beamed surface craft with a turtle-back deck, and numerous vertical and horizontal fins. This form and the fins were designed to prevent rolling, which was said to be very great in a submarine of the usual spindle-of-revolution shape because of the circular section. The facts that there is nothing

THE HOLLAND SUBMARINE TORPEDO BOAT. BOW VIEW.

to make a vessel roll when submerged, and that submarines practically do not roll at all when following wave slopes, were lost sight of.

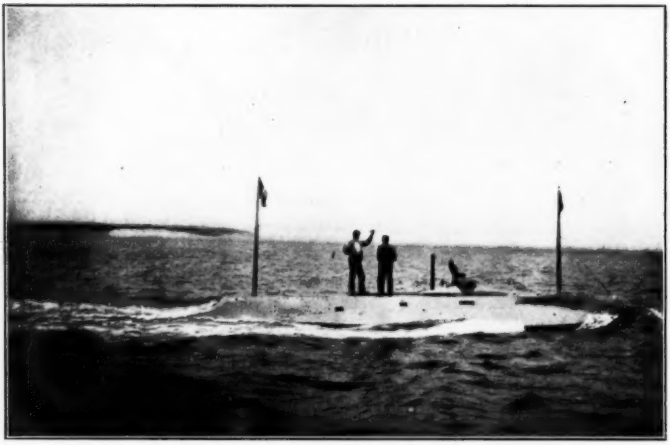
After the second proposals of Holland were put aside, the Baker boat was experimented with on one of the Great Lakes. Her salient features were adjustable-bucket side wheels, placed with their hubs in



STERN VIEW OF THE HOLLAND BOAT.

the midship section and adapted for directing the pull of the motive power in any desired direction and thus obviating the use of rudders. This device was found to be impracticable, for the same reason that it has proved so in surface craft—great waste of power.

On March 3rd, 1893, Congress authorized the building of a submarine boat, and after a third competition of designs and other delays a contract for a Holland boat was signed two years later. Details of the design were, by the contract, made subject to the Department's approval, and Mr. Holland claimed that some of these details as required interfered with the efficiency of the boat. This boat, the "Plunger," is not finished, the construction having dragged for many

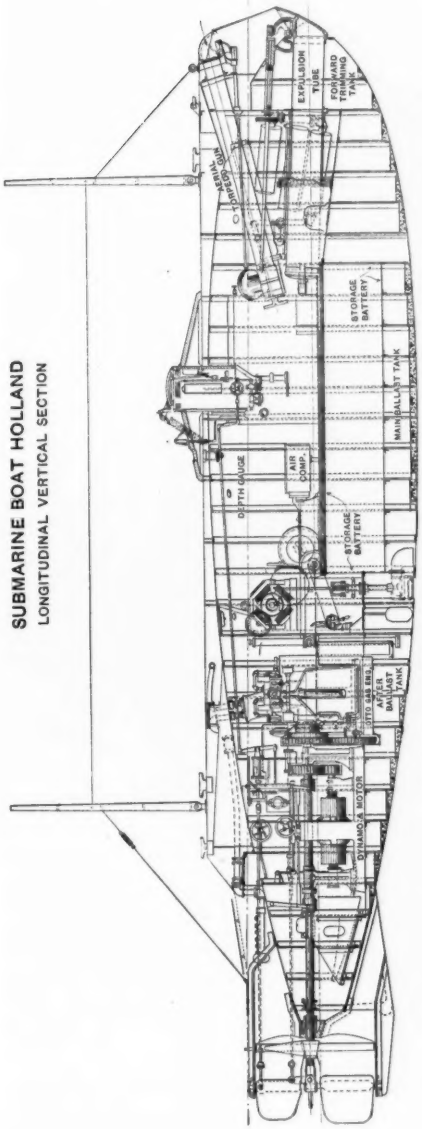


RUNNING ON THE SURFACE.

reasons. She is now undergoing a change in her surface motive power from steam to gas.

Meantime the Holland Company built a boat on their own designs, the "Holland," and she, last November, was reported by the Board ordered to observe her functioning, as fulfilling the requirements that had been suggested by the Department.

In the foregoing résumé of the development of submarines, I have attempted only to touch on such salient points as seemed to be illustrative, and have not attempted to record all the numerous endeavors to solve the problem of submarine navigation. In passing I would say that this development has already progressed far enough to produce two distinct types of practical under-water boats—the submarine torpedo boats like the "Holland" and the French boats, and the bottom



A NEW DESIGN FOR THE HOLLAND SUBMARINE TORPEDO BOAT

workers like the Travailleur Sous-Marin in France and the "Lake" boat "Argonaut" in the United States. Both these craft are intended for work along the bottom and both are arranged for use as a base from which divers in armor may work. The "Lake" boat gives good promise of efficiency. She is propelled along the bottom on wheels, after relinquishing all buoyancy while retaining her capability (by varying the amount of water ballast) of making herself weigh more or less according to the kind of bottom she passes over, and of making herself buoyant so as to rise over obstructions impassable for her ground wheels. At present she is not a true submarine in that she retains communication with the air by means of a tube. A boat of her type fitted with a true submarine motor might be very valuable for the attack of a mine field.

Turning to the type of submarine torpedo boat, we find that many of the desiderata for such a craft are found to be

impossible according to the showing made in the "Holland," which is undoubtedly the most advanced example. For instance, it is desirable to get speed as great as that of the fastest torpedo boat; to have very great radius of action; to have a means of directing the course by vision upon a moving object while remaining invisible beneath the surface; to have the vessel very habitable and comfortable for great lengths of time; to have unlimited quantities of air for power and for respiration by the crew. These are not attainable at present, and there is no prospect that they will be until some entirely new and most efficient way of acquiring power be discovered and until some startling discoveries in chemistry be made.

As the development seems to have reached very nearly to the limit attainable at present, it is only necessary to assign comparative values to the tactical elements established by the "Holland" in order to reach a conclusion as to the utility of the type. These elements are:

Theoretical radius of action on the surface by means of the gas motor, 1,500 miles. Satisfactory for a small craft, and probably as exact as the radii given for the men-of-war of the world.

Surface speed 10 knots. Unsatisfactory; but since greater speed cannot be gotten without increasing length and thereby decreasing perfection of control in the vertical plane, it is acceptable. It is also acceptable because the surface running is only made when proceeding to a field of action and when out of the zone of practicable gun-fire.

Submerged speed 7 knots for 50-miles radius of action; 10 knots or more at the expense of radius. Unsatisfactory, but sufficient to be formidable when operating from inshore against ships outside.

Control and direction in the vertical plane. Perfectly satisfactory, since the boat can be held within a very few inches of any desired depth while running, and can be brought to the surface and again taken under with exposure of the turret-top for only a few seconds.

Control and direction in the horizontal plane. Perfectly satisfactory when running on the surface, since the boat is then under conditions similar to those of any handy surface boat. Unsatisfactory when submerged, since the object to be steered for cannot be seen. Acceptable, because any predetermined direction can be held as well as can any vessel's course in a fog or in a dark night and in the same way, *i. e.*, per compass; also acceptable because the quick rises and dives enable the helmsman readily to correct his course to intercept an off-shore enemy endeavoring to close with the shore.

Ventilation. Perfectly satisfactory, since the necessity of keeping atmospheric pressure in the boat necessitates ventilation, and since

the compressed-air supply is ample for days when not used for mechanical purposes.

Field of vision when submerged. Nil, and therefore unsatisfactory as such; but acceptable because field of vision would carry with it the loss of the perfect invisibility which so largely adds to her effectiveness in attack, and because the quick rises and dives give perfect field of vision for a few seconds with a minimum of chance of disablement from gun-fire.

Habitability. Unsatisfactory on account of the cramped spaces. Acceptable, because she is sufficiently habitable to be endured for a few days at a time while lying off on picket duty, and because her crew can always be dry and warm and not suffer from heat as do the fire-room force of most naval craft.

Armament. Satisfactory, since it consists of torpedoes that can, from the conditions of fire, be delivered with accuracy fully as great as, if not greater, than can the same weapon from other types of craft.

Protection. Perfect, since neither gun-fire nor torpedoes can reach her when approaching to the attack submerged, and since the chance of her suffering from gun-fire when raising her turret a few inches above the surface for a few seconds is reduced to a minimum.

Sea-going qualities. Perfect, since no sea, however heavy, can affect her when in the awash condition ready to dive, and when running light she can always be dropped to the awash condition in heavy weather.

Surface motive power. Satisfactory, since it is the same that gives satisfaction in thousands of small surface craft using gas engines.

Submerged motive power. Unsatisfactory, since its source is the heavy and cumbersome storage battery. Acceptable, since it is the most available motive power for use when air cannot be freely used, and since the supply can always be renewed (when there is communication with the air by coming to the surface or by sending up a hose when the boat is lying on the bottom), through the use of the gas motor as long as the fuel supply holds out.

To my mind, the algebraic sum of the positive and negative efficiencies of the salient and determining features of the "Holland" type of submarines, in its present development, is a large positive quantity, and there seems to be no way of largely increasing it for some years. The capability of the craft for performing certain well-defined duties seems to be as well fixed by official trials as are the capabilities of other types of vessels by their trials, and the question arises, are these duties important?

From the report of the Endicott Board, from the oft-expressed opinions of Naval Officers, from the well-known condition of our coast defenses, fixed and mobile, even from a glance at the map of the United States in a primary geography—it is clear to the simplest mind capable of considering the subject that any enterprising enemy with whom we might engage in war would harass our coasts for the purpose of drawing our fleet into local coast-defense work and thus crippling its true war-stopping or war-waging power, by preventing the offensive work in which alone can its full power be utilized. It is apparent that coast defenses and fixed mines can do no more than prevent entrance to our ports; that surface torpedo boats, though very valuable, cannot meet battle-ships in day light; that coast-defense ships are either too expensive, if efficient, to be provided for the protection of all the points to be protected, or too inefficient if inexpensive.

The securing of our coasts so that our fleet may be free to do its legitimate offensive work is most assuredly a most important duty.

Can submarines do it? I have never heard a naval man of any nationality express the opinion that any battleship in the world could prevent, by her gun-fire or otherwise, the approach of a submarine of the efficiency of the "Holland," although many who have not seen her are quite positive that she cannot do what she does do, and has been reported as doing by a most careful Board of officers.

A sharp look-out would reveal the approach of a submarine in the day time and she might be picked up by search lights at night, as she rose to correct her course, although the chance of this would be very small, since she could readily avoid the search-light "lanes" arranged for defense against surface torpedo boats. When revealed she could be avoided by retreat, since her lack of speed would not enable her to chase a fast ship with any chance of success. Torpedo destroyers and other small craft thrown out in advance of the heavy ships could not stop her, since she could avoid them by diving and could continue to hold her course for the ships. If she were allowed to approach within good torpedo range her chance of delivering a torpedo that would put any ship out of the fight is exceedingly good; while the chance that a lucky shot from the enemy would destroy her as she rose and before her torpedo was sent, is extremely small.

Considering the hypothetical case of a single submarine defending a single point against a single ship, it is clear, if I am right as to conditions of present development, that the boat could force the ship away from the point of attack to a distance limited only by the fact that the boat must never be so far away from the point to be defended as to

allow the ship time to do damage in case the latter took the chance of doubling back to the attack after she had been chased off. With a group of boats in the defensive, some of the former would of course be held on the inshore lines to prevent such doubling back.

If a distance limit of effective work well within the capabilities of present development be arbitrarily fixed upon, and if the effect of submarines within this zone be considered, we may determine their availability for securing the coasts and thus freeing the fleet.

Let us assume twenty miles as this limit—one seventy-fifth of her theoretical radius of action and therefore that part of her possible limit. If the existence of submarines in the defense forced a blockading line of ships from the five-mile limit at which shore works might be expected to hold it, off to twenty miles, it is clear that the area to be guarded by the blockaders would increase sixteen fold and at least four times as many ships would be required to hold the line.

After carefully considering all the conditions, and after ruthlessly cutting down the efficiency shown on official trials, I cannot conceive why the answer to the question should not be: "Submarines can secure our coasts more perfectly than they can be secured in any other way at present practicable."

Providing coast defense ships enough for the purpose, one hundred and fifty or two hundred, for example, in excess of the ships of our seagoing fleet, would to my mind be impracticable on account of the great expense in time and the enormous expense in money.

The provision of a number of submarines would give a proportionate amount of coast security, since their presence would result either in the absence of hostile ships or in the giving to us a chance to oppose our small boat with its small crew to a large ship with a large crew, with the chances of war in favor of the boat.

As a designer of ships, the economy in leading other nations in the adoption of submarines appeals to me strongly. For experience shows that as soon as any particular kind of fighting craft appears in numbers sufficiently large to make the effect of that kind felt, it forces great modifications upon existing types. Whether devices be invented whereby battle ships can meet submarines, or whether they will continue to be vulnerable to offshore attacks as now, certain it is that the general appearance of submarines will force important modifications in design, and certain it is that the first country to accept the modifications will enjoy great comparative advantage in saving in her naval budget.

COMMERCIAL ORGANIZATION OF THE MACHINE-SHOP.

I.—THE CLASSIFICATION OF SHOP ORDERS.

By Hugo Diemer.

A MATTER of constant occurrence in manufacturing is that orders for machines are taken under condition that delivery shall be made within a certain time. Often this necessitates the rushing of work through the shops and the completion of machines which have been started on a stock order, or on some other order the delivery of which is not of so great importance.

If, as is frequently the case, a new order is issued for the completion of the work which has already been begun under a different order number, it will be seen that perplexing complications are introduced into cost figuring. I have seen orders worded as follows: "Complete immediately one of the machines begun on Order No. ——, and replace same." A cost clerk or cost department has, as a rule, sufficient troubles to contend with, without the infliction of needless complications like this. One of the best ways of overcoming this particular difficulty is the separation of all shipping orders as an entirely distinct series from shop orders. The clerk who enters shipping orders enters them simply in the consecutive order of their receipt, and it is not his business to determine from what shop order the goods are to be taken, or upon what shop order they are to be built.

Successful management is like the designing of highly efficient tools. It is based primarily upon the study of the best-known models and the adaptation of the best methods. Mr. Diemer writes as a practical man for practical men—clearly, definitely and concretely. His articles are essentially "working plans"—available for immediate use in the shop. They have stood the test of actual trial—have been "built from," so to speak. They are presented not as arguments, but as descriptions. All examples are drawn from shops whose splendid commercial success stamps the hallmark and guarantee of value on their methods. The order follows the natural course of work through the shops, and the whole scheme is thoroughly adapted to small and moderate-sized works as well as to large ones. It is practical, workable, usable discussion and exposition.

The following articles will be included in the series, which begins in this issue of THE ENGINEERING MAGAZINE:

I. **The Classification of Shop Orders.**
II. **The Production Department: Bills of Material.**
III. **The Production Department: Store-Room Management.**
IV. **The Production Department: The Execution of the Work.**
V. **Practical and Accurate Time-Keeping.**
VI. **The Figuring of Total Costs.**

When it becomes necessary to apply a machine from a stock order to some immediate-delivery job, it will be found most satisfactory to complete it under the order number under which it was begun, irrespective of the shipping-order number. In such cases a system of numbered memoranda or notes will be found to be of much value. For instance, the superintendent or head of production department writes a memorandum on a printed form with headings as suggested below:

INSTRUCTIONS TO FOREMEN NO... .....
SHIPPING ORDER NO.....
SHOP ORDER NO.....

Please note that it will be necessary to complete for shipment within ten days one of the machines on Order No..... calling for 10 machines Type N 27 for stock. The shipping order on which this machine is to be applied is No.....

As many copies of the above instruction sheet are made as may be necessary to give one to every department concerned and in addition preserve office copies for proper filing. In case it becomes necessary to stir up any particular department again, all that is necessary is to refer to the above instruction by number. This method insures the completion of every machine under the order number on which it was begun, which is absolutely essential for the accurate determination of costs of manufacture.

Suppose, now, that from a stock order calling for ten machines, four have been rushed through and applied to hurry orders. It still remains true that it will be very advantageous to have sufficient new castings made for ten machines of a kind to be run through all processes at once. The head of the production department now writes a note as follows:

INSTRUCTIONS TO FOREMEN NO..... ....
SHIPPING ORDER NO .....
SHOP ORDER NO.....

Please make the above shop order read 14 machines instead of 10.

Where specific reference to shipping orders is not essential, the shop-order number only is filled in.

It will follow, of course, that of the fourteen machines built, the four which were rushed through will have cost more in proportion than

the ten which have been put through all processes together, so that our cost will not give us the lowest price for which it is possible to build ten or fourteen machines; but it does give us the cost of the fourteen built under conditions which are bound to be more or less prevalent. To have issued a new order for completion of the four which had been already begun would have deprived us of the possibility of obtaining any cost figures at all.

I believe the most satisfactory system of orders is one in which, besides the entry of all orders consecutively as shipping orders, irrespective of what they call for, we subdivide the shop orders into separate classes or series. This subdivision should be done by a person thoroughly familiar with shop management. Thus we may have: "A," orders for complete machines which have to be built to order; "B," orders for repair parts which have to be built; "C," orders for any apparatus which can be shipped immediately out of stock, etc. There will be shop orders also for articles and operations which are not covered by shipping orders, such as orders for tools and running expenses. It is always desirable to know the cost of tools and machinery individually; hence it is bad practice to lump labor and material for all tools and machinery into standing shop orders which are closed monthly.

It will usually be found most satisfactory to have a separate series of orders for special tools which are made in the shop. Orders for tools may be designated, for instance, as "Order E." Besides special tools, such as jigs, dies, etc., there will be many small tools which are constantly wearing out. These can be made in quantity under orders in an "F" series. Small parts of machines which it is advantageous to make in quantity and to turn into the stock room will constitute a further series, "G." It must be borne in mind that such articles, placed in the stock room, must be considered exactly as material purchased, and proper credit given to labor accounts when their total cost is charged to "material"; otherwise they may be charged when completed in quantity and again charged when drawn singly from the stock room—an error which I have known to occur. We will next have an "H" series for drawings for standard machines, and an "I" series for patterns for standard machines.

Drawings, patterns, and tools that are likely to be special—that is, such as are used in the manufacture of special machines—should be put through under the order number of the particular job for which they are intended, so that the cost of the special job will include the cost of special drawings, patterns, and tools. It should be the duty of some one particular person to determine just which drawings, patterns,

and tools are to be considered standard. Usually the head of the draughting department is thoroughly competent to determine this question, and he is particularly fit to do so because naturally all operations begin in the drawing room. It will be found desirable for the drawing room to have a book or card index in which a record of drawings and patterns is kept, headed somewhat after the manner indicated in the form given below:

Drawing No.	Pattern No.	Article.	Shop Order.
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

In a certain case where the above form was used, it was found advantageous to keep two sets of records, one for the drawing room and one for the pattern shop. The pattern-shop form was identical with that for the drawing room, with the exception that the first column was headed "Pattern No.," thus:

Pattern No.	Drawing No.	Article.	Shop Order.
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

By means of these records, the history of a pattern or drawing may be obtained at once by looking up the shop order opposite the number of the pattern or drawing. It is not generally feasible to have pattern numbers identical with drawing numbers, since there will always be a great many more drawings than patterns.

Having prepared a complete set or series of shop orders to cover all articles for which it is necessary to have specific orders, there will still remain about the shop a certain amount of work in the way of maintenance and repairs, and certain material will have to be drawn from the stock room which cannot be charged to any specific shop order. The system of "Standing Shop Orders" is intended to cover this class of labor and material. The foreman of each department has a sheet of the following form:

SECTION.....

MATERIAL DRAWN ON STANDING SHOP ORDER DURING THE MONTH OF .....

Date	S. O. Order No.	Material	Quantity called for	Quantity delivered	Weight	Cost
....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	

He presents this sheet at the stock room for any material needed for use on standing shop orders. The stock room enters the quantity delivered and the weight. As soon as a sheet is filled, it is at once sent to the cost department. On the last day of each month all sheets are collected and new ones issued.

The list of standing orders will, of course, vary widely, depending upon the conditions in any particular shop. Merely for the purpose of illustration, a few items which would properly be included on the sheet are given below. The list of standing orders, fashioned somewhat like the pattern given herewith, is duplicated by the carbon or mimeograph process as many times as may be necessary to furnish every person concerned with a copy.

STANDING ORDERS.

S. O. No. 1.—Time of engineers and firemen. Labor and material for repairs and maintenance of power and lighting plant, including lamp renewals, arc carbons, etc. (Expense.)

S. O. No. 2.—Time of drivers and stablemen. Feed, labor, and material involved in maintenance of horses and wagons. (Expense.)

S. O. No. 3.—Labor and material for maintenance of yards and grounds. (Expense.)

S. O. No. 4.—Labor and material for maintenance and repair of buildings; time of janitors. Matches, soap, etc. (Expense.)

S. O. No. 5.—Repairs of machinery and shafting, repairs and renewals of belts. (Repairs Machinery.)

S. O. N. 6.—Repairs of jigs, dies, etc. Also new small tools, such as files; emery cloth, crocus cloth, etc. (Repairs Tools).

S. O. No. 7.—Repairs of patterns. (Patterns and Drawings.)

....

and so on.

If more standing orders need to be added at any time, care should be taken under no circumstances to change the numbers of any older

standing orders with which the personnel of the factory have already become familiar by number. Modifications of already established standing orders may at times be advisable, but the importance of adhering to the same numbers for the same general purpose is self evident.

Material which enters directly into manufactured products, such as material used in painting, varnishing, and shellacking, should be provided for in bills of material, although it may be necessary for the foreman of the paint department to estimate the particular quantity used on each order. Paint brushes and varnish brushes may be charged to a standing-order number.

The insertion of the account to which each order is chargeable is advantageous, because it helps to explain the reason for having a system of standing orders at all. Shop foremen take far more kindly to system, if they are treated as intelligent beings and are allowed to see for themselves why certain systems are necessary, than they do if they gain the impression that particular forms are thrust upon them simply because the management wishes to be arbitrary. This last impression is frequently produced by unnecessary reticence and secrecy where none is required by the circumstances. Be frank and open with your men and they will treat you likewise.

A careful classification of the particular items constituting the expense account under separate standing-order numbers will enable the management to compare them from month to month from the cost department's summary of these orders. Familiarity with the minutest details of the expense account is absolutely essential, for it enables the management to call attention to certain specific points instead of announcing the broad statement that "This expense account must be kept down." I know of a case where a superintendent, wearied by this constantly recurring announcement, gave instructions that all files, small tools—and, in fact, all labor and material generally that could be stowed away under customers' order numbers—should be so charged "in order to reduce the expense account." A conscientious manager, however, will not attempt to produce fictitious statistics, but will do all in his power to show existing conditions plainly as they really are.

THE FOLLIES OF SOME AMERICAN EXPORT TRADERS.

By an Export Salesman.

A SUBJECT which is attracting earnest attention in the United States at the present time is that of foreign trade, and the entry of American manufacturers as competitors in markets which they have only recently sought is exciting keen interest in England and on the Continent. A few glimpses of the matter as it appears when seen from the European buyers' viewpoint are timely, and it is with the assumption of this stand that the following observations are made.

The great question in foreign trade is: How can the buyer be reached in the best manner? This question may be met in a variety of ways, and my long observation leads me to answer it by showing "The Way Not to Do It," and adding thereto a few practical suggestions.

It is proper to state, at the outset, that products of the farm are entirely excluded from the subject here treated; the conditions governing the export of agricultural products, such as grain, hogs, and cotton, cannot be applied to the export of manufactured goods of any description whatsoever, for the simple reason that agricultural product is the product *par excellence* of the United States, and is one that the foreigner must have in order to sustain life; while the manufactured product, sold in competition with England, Germany, France, and Belgium, is sold to the foreigner, not because he cannot get along without it, but because in certain lines the American excels in the cheap and rapid production of the article sold, and in other cases because peculiar market conditions allow the American manufacturer to undersell his foreign rival.

There seem to be a large number of American manufacturers who think they want foreign business, but who want it only on the condi-

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The writer of this article— a salesman of ripe experience and proved ability—is particularly familiar with the Continental market for machinery, machine tools, and similar lines. His comments are addressed especially to American exporters, because his experience of their methods has been most extensive and vivid.

There are, of course, many American houses who are cultivating European trade with the utmost commercial enlightenment, tact, and adaptiveness; on the other hand, Anglo-Saxon intolerance of, or indifference to, the foreigner is by no means confined to the United

tion that it will fall into their hands at the expense of a few cents in postage for a letter, usually badly-written, in a language (English) of which so many of their prospective customers are totally ignorant, or know so little as to make the reading of it a Herculean task. It is obvious that such letters—frequently mimeographed, and badly at that—are treated as all circulars usually are, namely, thrown away. It would be curious to note the effect of a circular of the same kind, written, say, in Hungarian, to one of these same American houses, offering goods to the recipient that he did not want and had no interest in; yet the same effect is produced in Europe by hundreds of such circulars received in the various trade centres every day.

"Circularising" Europe from America for business does not pay under any circumstances that have ever come under my notice; but circularising Europe *from some point in Europe*, for the same class of goods, can be made to pay, and pay handsomely. It is not to be expected that buyers will take up an article about which they know absolutely nothing but what they can learn from circulars and subsequent letters (admitting that the recipients of the circulars may write to the senders of the circulars), when they have the very thing, or practically the same thing, right under their hands all the time, for sale by their own people, speaking their own language, with every facility for immediate shipment and with sufficient stock in hand to enable deliveries to be made the day the order is placed.

The next catalogue of would-be exporters are those who calmly demand of a consul, as a divine right, that their name and address be handed to each and every buyer in their line in the district to which the consul may be accredited; this is such a blatant absurdity that comment is superfluous; yet I have under my hand at this moment such a letter, and I have seen others. I have had such letters handed to me by consular officers with the suggestion that the firms sending them be addressed in the hope of obtaining information or prices; eighty-five per cent. of such houses, doing probably a large and successful busi-

States, and the Briton, as well as the American, may take warning by the "horrible example" depicted in the article and profit by the contrast afforded by the careful and painstaking German. To the manufacturers of the United States and to their commercial and industrial rivals, their increasing attention to export markets and their attitude toward the foreign buyer are alike matters of extreme interest.

True and dispassionate criticism is one of the rarest things, hardest to be come at by entreaty or purchase, but of most value when it can be had. Unfortunately, not everyone appreciates faithful correction by his friend, nor can dissociate criticism and the critic, who may therefore suffer in his person from the displeasure which should be directed against the fault he has pointed out. For this reason the writer of this article prefers that his name be not publicly used; but if any of our readers are so interested as to desire to follow the matter further, we are authorised to give his name and address to such applicants, and will take pleasure in giving prompt attention to their inquiries.—THE EDITORS.

ness in the United States, make the feeble effort just cited for foreign trade, and do not even reply to letters written them in response to one of their circulars; this has been the case in my experience over and over again.

It would be interesting to ascertain the value in dollars and cents accruing to the American manufacturer in general, and to the "commission houses" in particular, from the immense amount of work put upon American consular officers abroad in the preparation of the special reports published in book form every month by the State Department at Washington, and disseminated throughout the country for the benefit of American commerce.

Yet a lot of manufacturers of a special line of goods will induce the State Department to order its representatives abroad to study and make an exhaustive report, on the plea that business can be done. These very people, or people in the particular line of manufacture in question, upon being addressed for prices, etc., will either not reply at all, or else say: "Our experience goes to show that foreign business is so very unsatisfactory that we do not care to quote for export, being convinced that there is nothing in it." This useful information is sent abroad either with no stamp or with a two-cent one, the result being that the unfortunate foreigner has to pay from six to ten cents to receive the communication.

Still another class is the one that will gladly give all information, and wind up by intimating that cash in New York is a *sine qua non* to any business; and they give explicit directions about opening credits, etc. Many American manufacturers do not seem to realise the fact that there are as many people in Europe with financial honour as there are in America; and those merchants or manufacturers who make a practice of insisting on cash before shipment, especially for such articles as canned goods, fruits, and other like products, are generally wasting their time in their effort to create a market. It is a deep mystery to the average understanding why an American exporter should expect his foreign customers to trust him implicitly, while he places absolutely no reciprocal trust in his correspondent's honour or integrity. A glaring instance of this came under my personal notice a very short time ago; a house was addressed with the request that certain prices, etc., be forwarded for the consideration of a company who desired to buy about seventy thousand francs' worth of the particular line of goods in which the exporter was interested; the reply came back very promptly, and was to this effect: that the buyer in Europe should pick out from various catalogues the goods wanted (these cata-

logues to be found by the buyer, none being sent), submit the list to the exporter, and let him make the prices on the understanding that all the goods were to be paid for before being let out of the exporter's possession, the payments to be made in New York by means of credits to be opened. To make such a proposition as this to a company having a million and a quarter of francs—$250,000—in bank all the time, and a paid up cash capital of four times this amount, would have been followed by the immediate and effectual "firing" of the proposer from the offices of the company in question.

Before leaving this particular variety of exporter, there is still the one who says that cash against shipping documents is not necessary, but the acceptance of time drafts before the goods will be delivered is the only way in which business can be done. Exporters can figure out for themselves the effect such a proposition would have on the very largest and richest of their own American customers; in many lines in Europe, such as gas-plant supplies, water-works goods, and supplies for electric street roads, the cities themselves are the buyers, and these cities have the misfortune not to be ruled by any Tammany cliques—which means that no one has to be "seen" in order to get the business in sight; but hard as it is for a foreigner to get in, if the additional handicap is thrown on the seller of having to ask some one in the city government for such security as accepting a draft, such a course would make business impossible. The cities all have their regular pay days, and it is not possible to make them deviate one hair's breadth from their rules as to payments. The manufacturer on the spot is only too glad to accede to the terms of his buyers, be they cities, corporations, firms, or individuals; but he first takes care to do that which the exporter will not do, viz., satisfy himself as to the credit of the prospective customer before he begins to discuss or undertakes to dictate terms of payment.

The most remarkable thing is the indifference to foreign trade exhibited by American manufacturers, high and low, big and little, during busy seasons at home. A more short-sighted policy could not well be imagined than to tell the foreigner that there is no time to bother with him because of the press of domestic orders; yet this very statement was made to me when I humbly requested one of the largest of the new trusts for a price on over a hundred thousand dollars' worth of material, deliverable, so to speak, at the convenience of the manufacturer. The amount of damage that has been done in the past eighteen months to American manufactures from exactly such causes as the foregoing will be seen immediately business begins to fall off in

America, and the people who will reap the benefit of this policy will be America's great commercial rival, Germany. A German manufacturer is never too busy to get a new customer, and he always has the time to study the customer's wants and to supply him with what he wants, instead of making the never-ending excuse that some of the goods required are not "standard" and that he cannot undertake the business, except at exorbitant prices.

To sum up, then, as to the methods that will secure foreign business, the following is put forth with diffidence, and with the statement that the suggestions are not intended to be taken as perfect, as incapable of being changed to meet peculiar conditions, or as possessing originality. On the other hand, it is claimed that, if followed out, the suggestions will increase the foreign trade of the United States with Europe on manufactured goods.

This is the summary:

Write to your customer in his own language; or, if this be not possible, write in French to the Frenchman, Belgian, Italian, Russian, and Scandinavian, and in German to the German, Austrian, and Dutch. It is vastly better to write to every continental firm in French than to use English; they one and all would prefer a badly written French or German offer to a well written English one. The time will come when English will be universally spoken, but that time is far off yet.

Write letters; do not print them—that is, do not mimeograph and send forth broadcast thousands of letters which generally come to nothing in the shape of business.

Give full and concise answers to letters asking questions, and do not put your correspondents off with evasive replies, which, alas, is such a prevalent error.

Do not expect the American consular officers to transact your business for you; pay an agency similar to the Bradstreet and Dun companies to tell you who and what the people are with whom you wish to deal.

Go after the foreign business exactly as the home business was sought; that is, pay some intelligent man enough to make it an object to him to represent your goods in the best light; in other words, spend money to get the business in the same manner that money was spent to get the domestic trade.

Do not start out with the idea that all foreigners are *ipso facto* dishonest or unwilling to pay for goods they may order. Take the time and trouble to ascertain something about the financial responsibility of the house to whom you wish to sell goods, and then accord it the same

treatment you accord to your domestic customers whom you know to be solvent.

Do not scorn foreign business because domestic trade is good; it is a well known fact that trade moves in cycles of prosperity and depression; in prosperous times like these merchants can well afford to spend money in order to "lay pipe" for foreign trade when the domestic depression comes.

Finally, ship exactly what you agree to ship, and at the time the goods have been promised; nothing is more exasperating to the foreign buyers than being continually put off with excuses for non-shipment of goods promised for a certain date, notwithstanding the cast-iron rule printed at the head of so many manufacturers' letter paper to the effect that they will not "be responsible for strikes, and other causes beyond our control." This is probably the most elastic clause that has ever been invented, as it can be made to mean anything and everything.

Promptness, accuracy, confidence, perseverance, and fair dealing are the five key words to the success of securing and holding foreign business by American manufacturers. Promptness in answering letters, accuracy in the filling of orders, confidence in the integrity and solvency of the foreign buyer, absolutely fair dealing in all transactions, great or small, and perseverance in everlastingly "sticking at it" —will bring a golden harvest to the American manufacturer in the European field. Without these five cardinal virtues, and unlimited patience, efforts will be futile, or the returns from such efforts will be very small and insignificant.

RUSSIA'S FIELD FOR ANGLO-SAXON ENTERPRISE IN ASIA.

By Alexander Hume Ford.

ASIA is destined to become the theatre of the greatest engineering feats of the coming decade — military or commercial — perhaps both. Russia, partly with Anglo-Saxon gold, is pushing railways into Turkey, Central Asia, Persia, Afghanistan, Siberia and China. Her great engineering problems are being overcome by Anglo-Saxon ingenuity. The steel bridges over the broad rivers, the locomotives traversing the vast steppes, the steel rails, the track-laying tools and labor-saving devices which have made possible Russia's phenomenally rapid railway advance into Asia in the last few years—all are ours, even to the air-brake system, with which all the Russian railways are being supplied. With orders amounting to $12,000,000 for material alone with which to complete the Chinese Eastern Railway, pouring into America and England, what future requirements we will be called upon to supply, when Russian railways reach Persian ports and the vast territory of Central Asia is opened up to our trade, can not even be conjectured.

The building of the Chinese Eastern Railway through Manchuria poured millions of Russian roubles into the pockets of American and English manufacturers of machinery and railway supplies, and has opened up a vast new territory in which will be expended much restless energy of the Anglo-Saxon race in the next ten years.

In the editorial pages of THE ENGINEERING MAGAZINE for May, comment was made upon the extent to which the United States were supplying the markets of Eastern Asia. Mr. Ford, who has recently returned from an extended tour through Manchuria and Eastern Siberia, as well as Japan and other longer-opened territory in the Far East, gives the testimony of an eye-witness. His graphic portrayal of the industrial situation and the meaning it has for England, America, and Continental Europe, is full of the keenest interest. It has the personal force of direct individual observation and report.—THE EDITORS.

Besides railway materials, bridges, and all kinds of machinery, every species of farming implement, from the humble plow to the mighty mower and reaper, must be imported from without; and it should not be forgotten that Anglo-Saxon material has driven all the Continental countries out of competition in Manchuria within a period of less than two years.

Russia, with her dozen or more railways rapidly penetrating into Asia at every conceivable point, is developing a continent containing one-half the population of the world. It will be many years before she can supply the mechanical needs of these people, to say nothing of the requirements of those who emigrate by the thousand into the newly opened territory. Although the Czar is calling upon Anglo-Saxon engineers to equip his railways with machine shops containing all known modern appliances, it will take some time for the mechanics of other nations to supply the equipment needed to enable Russian

THE FIRST AMERICAN LOCOMOTIVE ON THE CHINESE EASTERN RAILWAY.

engineers to build their own locomotives. Machinery for factories of all kinds, flour mills, breweries, and electric light plants, is still pouring into Siberia and Russia from abroad.

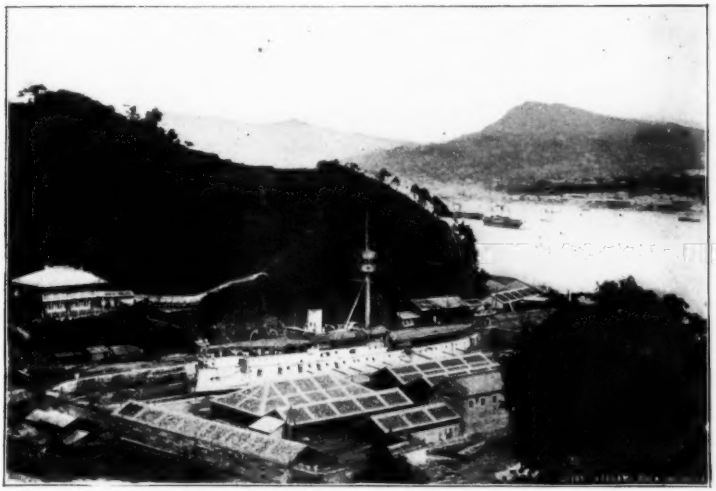
Russia will not reap the first fruits of her railway invasion of

Asia. She is not the rival in the construction of her railways to be feared by the Anglo-Saxons. A new power has risen at the very doors of Asia. Forty million progressive, irrepressible Japanese stand ready, by force of arms, if necessary, to open the door of new Asia to their manufacturers. It is the only hope of salvation for the overcrowded Island Kingdom, and its people will fight for this last chance with desperation. Already Japan is beginning to undersell other nations in supplying material for the Siberian railway, and Russia will buy in the cheapest market.

Last July Japan entered the family of civilized nations, becoming by treaty everywhere open to foreigners. She will multiply her machine shops and factories, besides inviting capitalists of all other nations to enter Japan and erect plants where coolie labor is cheapest. Even now Japanese ships convey freight at almost a nominal tariff, and with the open-door policy enforced in Asia, Japan will doubtless be the greatest gainer. Already her merchant marine is driving other vessels out of the far eastern seas, and Russia holds her own on the water only by most stringent restrictions against Japanese vessels.

With the imminent possibility, if not likelihood, of an early war between Japan and Russia for commercial supremacy in China, with

A SHIP OF OLD JAPAN.
The style of vessel used by the company preceding the Nippon Yusen Kaisha.

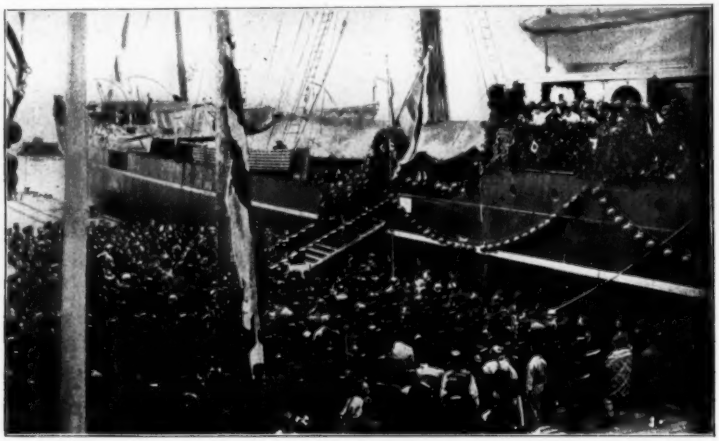


THE TATEGAMI DOCK AT NAGASAKI.
Where Japan builds her own modern warships.

England on the side of Japan and France on the side of Russia, a brief review of Japan's commercial rise to competition with the so-called civilized nations will go farther than anything else toward giving a clear insight into trade conditions and the future of Anglo-Saxon commerce in the Far East.

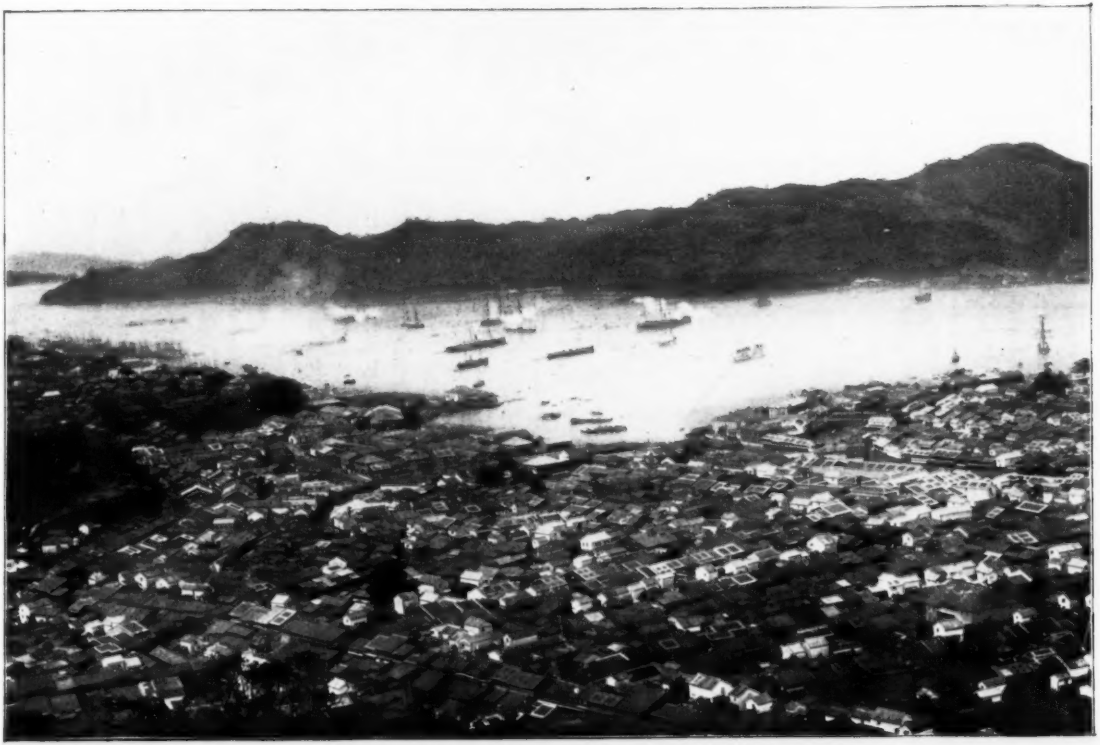
With Japan's awakening thirty years ago, England was called upon to build railroads everywhere in the Mikado's Kingdom. The Japanese, being natural born mechanics and engineers, soon learned the methods of the machine shop, and now Japan builds and equips her own railways and the English engineers have been relieved, so that a white-faced employee is never seen on a Japanese railway today. Foreigners no longer drill her army, Anglo-Saxons no longer man her ships. The native junk of thirty years ago has given place to magnificent ocean steamships which the Japanese have learned to build. England and America are still building war-ships for Japan, but at Nagasaki last summer I noticed the government was constructing at least a dozen torpedo boats, while in the immense dry-dock one of her largest war vessels was undergoing repairs. At the government ship yards war vessels are now built by the Japanese, and the days when such ships will be purchased from foreign constructors will soon be past. The same holds true of the merchant marine. One com-

pany, the Nippon Yusen Kaisha, which a few years since owned only a few sailing vessels, now possesses a magnificent fleet of ocean steamships, nearly one hundred in all, with lines to America, Australia, London, Hamburg, France, the Philippines, and India, to say nothing of the local branch lines to Chinese and Siberian ports. These boats, manned by Japanese crews even to the engineer, have played havoc with the freight and passenger rates not only in the east, but between America and Asia, as well as between Europe and China. They threaten to drive all competitors from the Pacific ocean, and there are those who believe Japan will yet become mistress of the seas, and displace England from her high place, commercially at least.



INAUGURATION OF THE NIPPON YUSEN KAISHA LINE OF STEAMSHIPS TO EUROPE.
President Kondo delivered an address at Kobe from the deck of the Tosa Maru, the pioneer steamer of the line, March, 1896.

England developed the engineering genius of the Japanese, and British firms led the way into Central Manchuria after Russia had once begun to develop that country. Commercial and national rivalry do not always work injuriously to each other, for shortly after England's naval demonstration protesting against the Russian occupation of Port Arthur, the Czar's government placed enormous orders in London for material to insure the rapid completion of a railway that would connect St. Petersburg with Port Arthur and throw Manchuria inevitably into the possession of Russia, and this development of northern Asia was brought about with a marvelous rapidity not equalled even by the settlement of some of the western United States.



THE HARBOR OF NAGASAKI, MEN OF WAR AT ANCHOR.

Cities and towns sprang up in a night, and European Russia began pouring into Manchuria a steady stream of immigration which is still flowing into that country in greatly augmented volume. Steamships were chartered in England, and several lines between the Baltic and the Black Sea and Russia's new possessions in the Far East were put into operation.

It was necessary to build the railroads through Manchuria by the sole aid of vessels. From every quarter of the globe material and supplies come by water to Port Arthur, Vladivostok, and the Amour River. Orders were at once placed in England for fifteen steamers and forty steel barges to be sent in sections to Vladivostok. These were taken by rail some two hundred miles overland to the head waters of navigation of the Usuri River; here they were put together and loaded with rails, locomotives, and machinery, and began their two-thousand-mile journey down the Usuri to the Amour, up that noble stream to the Sungari River, and thereby into the centre of Manchuria. The last-named river is crossed by the Chinese Eastern Railway at three different points, hundreds of miles apart, and from its banks, in both directions, the railroad was begun at several points. Some of the steamers were employed to carry material and track-laying tools to Stretynsk at the head waters of the Amour, and here again, at the present termination of the Trans-Siberian Railway proper, track-laying toward St. Petersburg was begun.

It did not take the news of the opening of this great territory long to reach America. Soon the finest business house in Vladivostok was erected by an American, the most spacious Chinese structure in Port Arthur was secured as an agency, and the introduction of American tools and American locomotives was begun. American activity was abroad in the land, and while the Russian engineers at first laughed at the idea of American manufacturers competing with Europe, they were induced to give a few orders. To their astonishment the goods arrived in less than three months and proved the most durable and efficient tools up to that time imported into Manchuria. The Russian officials suddenly realized that just across the Pacific pond, not five thousand miles away, they could supply all the needs of the new railway, and all hurry orders were promptly cabled to America, whose markets were some fifteen thousand miles nearer Eastern Siberia than those of Europe. American engineers who could speak the Russian language fluently enough to converse in technical railway terms with the Russian officials of the railway found that a golden stream flowed through their hands to the manufacturers

in America. Last summer the Chinese Eastern Railway went so far as to send over two of its engineers, as a committee, to visit and report on the outlook in the United States of procuring every kind of railway appliance. They reported that more than three-fourths of the material and equipment still needed for the completion of the Trans-Siberian Railroad, as well as the steel bridges, could be procured in America, of a better quality and more cheaply than in any European country.

Since then Russia's railway projects in the Far East have been greatly augmented, and recently cablegrams were sent over for material for a branch line on to Peking, so that now Russia is building with all speed from four Pacific Ocean ports (Tientsin (Peking), New Chwang, Port Arthur, and Vladivostok) toward her great Trans-Siberian system, and tons upon tons of machinery from the United States lie stacked upon the wharves of these cities, so adjacent to the western seaboard of the United States. Already the railroads

ON THE WHARF, VLADIVOSTOK.
Landing American rails from a steamer.

extend for many miles into the interior from these ports, and in fact, before spring navigation is opened, it is expected that they will all be connected with Harbin, on the Sungari River, which is the central point of meeting for the lines in Manchuria.

This city is not yet a year old, but it contains many thousands of inhabitants, spacious office buildings, splendid machine shops, asphalted pavements laid down by American steam rollers, and a Yankee electric-lighting plant. Harbin is also the winter quarters and general terminus for the line of English steamers and barges. All that remains to be built of the Chinese Eastern Railway is a partly completed section eastward from Harbin, through the mountains of Manchuria to China on the line of the Trans-Siberian Railway. It is the most difficult section of the entire Trans-Asiatic undertaking, but it is confidently expected that within another year it will be completed to such an extent that, by utilizing the frozen rivers in winter time, temporary tracks can be laid and through trains run from Peking to St. Petersburg.

Forests are being cleared, workshops established, towns and cities

located, and drainage systems laid out, in anticipation of the coming population that will pour in from Russia when the new road is opened. Freight and passenger tariffs will be extremely low, intending settlers being able to travel third class from Moscow to Manchuria for about forty dollars or less. Already the advance guard is beginning to raise wonderful crops of wheat, and more than one completely equipped flour mill has found its way across the ocean to be erected in central Manchuria. Gold mines are being opened up, and the whole country seems to be on the verge of a boom which will doubtless soon bring about the consummation of the much talked of direct steamship line between the Pacific coast of North America and Russia's Far Eastern ports. As matters now stand all freight is trans-shipped at Nagasaki, and either the Japanese or Russian steamship lines transport it to the required destination. This, of course, entails an enormous expense, which practically puts England, although ten thousand miles further away from Siberia than the American Pacific coast, on an equal footing if she can send her goods direct to Vladivostok by tramp steamer; but even by this roundabout route,

THE VLADIVOSTOK WHARF.
Divers recovering rails which have fallen overboard during unloading.

New York is competing with London, for a regular freight line is now established between the former port and eastern Siberia.

Russia having forced the Government at Peking, after the seizure of Port Arthur, not only to grant extensive railway concessions in Manchuria but to assist in carrying out the building of the road, other European nations, and even American capitalists, beseiged Peking and demanded various concessions in every portion of China, and with such success that the Celestial Kingdom is to-day surveyed for a network of proposed trunk lines, some of which are under construction. The majority of these concessions are either Russian or English, and, with the exception, perhaps, of the comparatively insignificant German concession, doubtless Anglo-Saxon material will build all the railways now proposed in China. Not only that, but as the rich iron and coal beds are opened up in the interior, England and America will be called upon for the heavy machinery, and as factories are established the equipment must come from without. It will be some time, however, before China will take kindly to modern machinery. Foreign investors have discovered, after erecting expensive plants, that coolie labor at a penny a day is cheaper than steam power, and at Hankow the tea merchants have gone back to the hand-pressing process of packing brick tea, as more economical than burning coal to run the compressing plant.

The French in Burmah are using American material in the construction of some of their railways, and American rails and locomotives are beginning to find their way even into India. While England will not listen for a moment to the proposition that Russia shall extend her Central Asian line from Herat to the Persian Gulf, doubtless when it has become an accomplished fact there will be a lively rivalry between the manufacturers of the two Anglo-Saxon countries as to which shall supply the bulk of the material for the construction of the vast gridiron of steel with which Russia has planned to cover Turkey, Persia and the entire Trans-Caspian country. It should not be forgotten that Prince Hilkoff, who is at the head of the railway system of Russia, received his engineering education in the employ of American railroads, and is thoroughly conversant with the technical details of all the most recent railway and mechanical inventions and devices of the Anglo-Saxon. No English or American engineer need hope for actual employment in connection with these enterprises of Russia, but the great bridges will be built in America, and American engineers will design them. American manufacturers will send men into the new country to study the peculiar class of ma-

terial and form of construction made necessary by the contour and climate of that part of the world, and, as the Russian government is contemplating spending additional millions on irrigation works, machinery for dredging canals, and later, machinery for sowing and gathering the great cotton crops, will be imported on a large scale.

A STREET SCENE IN VLADIVOSTOK.

The dummy line on the left was laid with the first American rails sent to Siberia.

What changes will be made in Russia's railway plans on account of the entrance of Germany into Turkey remain to be seen. While Russia has always regarded this as her future possession, England has successfully kept her from actual inheritance, and now that Germany is gridironing Turkey with steel rails it is quite likely the two countries will come to an understanding, for the building of Russian lines through Persia to connect with the Turko-German railway will enhance the value of both. Germany, of course, will build her own roads; but the development of Turkey will in many ways be turned to the profit of other nations

Russia still places as much dependence on her internal waterways, as means for the carriage of produce, as she does on her railways. Great ship canals are being built through the Empire, connecting the

Baltic with the Black Sea and the Arctic with the Caspian; again, it is hoped to connect the Caspian with the Sea of Aral, thus bringing all central Asia into easy water communication with St. Petersburg and all parts of European Russia. The lesson of the Chicago canal has not been lost on the Czar, and his representatives have carefully studied the mechanical development in canal building displayed in Illinois, for the canals of Russia also pass for the most part over great level steppes.

And so, hand in hand, railways with waterways, Russia goes on extending her empire, spending millions on these internal improvements instead of on foreign wars. The government guarantees the interest on the money invested, and indirectly, if not directly, reaps a rich reward in the enhanced value of the land traversed by the canal or railway. Especially is this so in the case of the Trans-Siberian railway. No land grants were given to private corporations, but hundreds of thousands of peasants poured over the Urals, land was leased from the government direct, and the great broad acres of Siberia were planted in wheat. The government encouraged modern methods, and again America and England were called upon for plows and reaping machinery. The new lands yielded marvelous crops, so that for hundreds of miles it has been necessary to parallel the Siberian railroad by another, some miles further north, and even then it has been found that the single-track system is inadequate to transport the enormous crops of wheat, so that thousands of tons of grain are left at the various stations to rot in the open air, while people in central Russia are dying of famine. And now the great rivers of Siberia are to be used to export grain and coal, and to import machinery. The Trans-Siberian railway has been extended across northern Russia to Archangel on the Arctic Ocean; from this point ships can sail in summer to the mouth of the great Siberian rivers, the Yenisei being navigable to within a few miles of Lake Baikal. Efforts are now being made to dredge the separating barrier, when the waterways of Mongolia will be opened up to direct internal water communication with Russia proper. Anglo-Saxon influence is largely responsible for the great awakening in Siberia.

The men who read Spencer and Ruskin were transported by thousands to Siberia; after serving their terms in prison, they were compelled to settle in Siberian towns; their influence was felt, so that today Siberia is by far the freest portion of the Russian empire, and many of the Czar's people emigrate there to enjoy the larger liberties allowed. Cities have sprung up, peopled mostly by the political exiles,

all men of advanced ideas. Many of those stationed near Vladivostok have escaped in sailing vessels and found their way to America, and after learning the English language have returned to Siberia in the capacity of business agents for American houses. The officials have winked at the return of the exiles, and to-day there is a kindly feeling towards Americans from one end of Siberia to the other. The recent influx of American machinery has not been met with any animosity, but, on the contrary, the Siberian engineers constantly urge the officials at St. Petersburg to allow them even more latitude in ordering building material from across the great Pacific pond.

The prospects for the next decade point to a demand in Asia for the greatest engineering contrivances and equipment ever known in the history of the world. France, Belgium, Germany, England, America,

THE HOTEL AT VLADIVOSTOK.

and Japan will contest for the privilege of supplying most of this material. Already America has placed her first entering wedges. In Korea the electric railway in the capital city is an American enterprise, the mines are being exploited by American engineers, and new concessions are being frequently asked for by American citizens. Russia and Japan both look on with envious eyes, and Japan is pushing her railway

on to Seoul, with the hopes of soon monopolizing the Hermit Kingdom and incorporating it in her own domains—in which case, of course, Japan will make her own improvements with as little outside aid as she can get on with. And as Russia is also pushing her railway toward Korea, this little country is likely to be the scene of the next Asiatic war.

England, who is friendly to the United States, practically controls all of China south of the Yang-tse-Kiang, and India; and all west of this remains for the present an open question, with the chances of Russia solving it in her favor. But that several Trans-Asian railway

NEW JAPAN. A STREET SCENE IN KIOTO.
The trolley cars are of American manufacture.

lines will connect Paris and London with the Pacific Ocean, within the coming decade, there remains no doubt; and, besides these, there are the lateral lines which will necessarily be built.

A whole new continent is being educated up to civilized wants. Asia, from now on, becomes the engineer's paradise, and it remains to be seen whether Anglo-Saxon push will continue to control and supply this great field, or give way before the wily Slav, or the agile, hardy Jap. Doubtless there will be work enough for all, once the coming development is well under way.

NEW SHOP METHODS A COROLLARY OF MODERN MACHINERY.

An Editorial Comment.

IT is clear that no settlement of labour questions can be stable which is not founded on uniform justice, and which does not make its justice and fairness evident to both employers and employees. Force may triumph for an hour, but reason alone can maintain an abiding rule. As Mr. O'Connell puts it in the following article, to which these paragraphs are but an introduction and preface, coercion, as between managers and men, whenever and wherever it is applied, is sure to fail in the end. It is with the earnest hope, therefore, of aiding in bringing about an understanding between manufacturers and workmen that THE ENGINEERING MAGAZINE has opened its pages to the leading exponent of American organised mechanical labour, and invited a statement of the views of the machinists' union upon the newer systems of management and the plans of wage-fixing, which, from the employees' point of view, are thought to be fairest and most enlightened. The side of the employer has been ably and often stated in this magazine, in many relations and under various lights. Mr. Orcutt, Mr. Jeans, Sir Benjamin Browne, Mr. Slater Lewis, Mr. Henry Roland, Mr. Norris, Mr. Hoyt, and many others have argued the case in papers whose strength was impressive and whose spirit of fairness and desire for justice must have been apparent to all. Mr. O'Connell, as the official exponent of the views of organised American labour, has been asked in the same spirit to join in the discussion, and to define the attitude of the employee—to show wherein his estimate of the situation differs from that of the manufacturer, why he opposes methods and movements which to the employer appear indispensable, and what alternative he proposes sufficient to meet the needs of the case and the evident tendencies of modern production. For the first requisite of agreement is mutual understanding of one another's views and of the approaches by which they have been reached.

THE ENGINEERING MAGAZINE, however, adheres firmly to the opinion which it has consistently maintained and to which it has frequently given editorial expression—that the irresistible tendency of progress in industry is toward intensity of production and toward

differentiation of the individual; and as the piece-rate and premium systems are in direct accord with these principles, they seem certain to prevail in spite of the fear and the disfavour with which they are now regarded by the labour party. If they did indeed foster all the evil tendencies summed up by Mr. O'Connell, they would need no organized antagonism to overcome them; they would die of themselves, like discords, killed by their own internal conflicts. It would certainly seem to need some positive demonstration that they do so direfully affect the nature of the worker under them—that greed and cupidity are stimulated by a fair opportunity to do better work for more wages; that Jekyll becomes Hyde when he strives to make fuller use of his own natural faculties and the mechanical equipment provided for him; that the milk of human kindness remains sweet in the individual who turns ten castings a day on his lathe, but sours in him who tries by more careful attention and forethought to turn eleven or twelve.

If there were in fact but a fixed amount of work to be done in the world, by sharing which accurately a limited number of artisans could eke out a living, the strong man who in his strength jostled his weak brother aside, that he might secure more than his own share, might receive condemnation, but that fallacy was too long ago thrown onto the scrap heap to be brought out again. It is universally true and almost as generally recognised that every cheapening of production brings a more than proportionate increase of consumption. There is no greater benefactor to the whole race, from a material point of view, than the man who, by diligence or inventiveness, makes one hour of labour suffice for the work which formerly took two. His blessing is like in kind and great in proportion to his who makes two blades of grass grow where one grew before.

And in the machine trade the reward is peculiarly direct and cumulative, for the reason that, as some one has observed, the machine tool is directed to the processes by which itself was made—the tool, to a large extent, makes other tools. If the designer or the operator can make it turn out these new tools more cheaply, there is, first, an enlarging market for the product, more of the manufactured tools bought, more operatives needed to carry on the tool manufacture; but there is, next, the parallel increasing demand for new operatives to tend the manufactured tools. More tools built, more tools occupied in building—more machinists to care for both; the reward comes home immediately to the machinists' trade, which enjoys, further, its proper share of the generally reduced cost of living and increased

scale of comfort which attends every improvement in manufacturing processes.

The movement toward the utmost intensity of production is only another cycle of the progress which began with the introduction of machinery. The effort to resist it is as futile as the opposition to steam has long since proved itself to be. Almost every step of the advance of power-using has been fought against the opposition of labour, more or less organised if only by its common fear that it was about to be crippled or even destroyed. The direct outcome of that steady, and sometimes cruel, advance is the enormous body of mechanical labour the world over, a body of which the powerful organisation represented by Mr. O'Connell, and its kindred union, the Amalgamated Society of Engineers in Great Britain, are only chapters. One need but read the logic of events to see that the triumphant future of the machinist lies forward in the same path. To attempt to crystallise conditions as they are now is inevitably to become atrophied, fossilised—extinct. This is the sort of "coercion" which everywhere and always will irresistibly prevail. It is not coercion of the employee by employer; any attempted coercion of the employer by the employee it will finally and surely overcome by counter-pressure. It is the inflexible coercion of evolution, forcing employer and employee alike along the same path. The things which are in accord with it will prosper, serve their uses, and eventually give place to still more highly adapted institutions; the efforts which oppose it will certainly go down in more or less complete ruin as they prove finally less or more adaptive to the inevitable.

This may seem a picture of:

> " * * Nature, red in tooth and claw
> With ravin, * * "

but such a view will hardly stand against the calm marshalling of the facts. "Intensified production" carries no inevitable corollaries of greatly increased bodily labour, of physical fatigue and mental exhaustion. The constant and rapid tendency in every line is to emancipate the manual worker, to free the muscles and to a very great extent the mind of the labourer. He directs—the machine *does*. The number and range of machine-shop processes in which the operative is an overseer only is on the rapid increase, and even the oversight is being continually made easier. Not only the tireless energy of steam or electricity, but the never-sleeping thought of the master mechanic are animate in the tool. The tool attendant is relieved to a maximum degree of physical and mental strain; his part in the scheme of enlarged

output is largely one of watchfulness and forethought—of skill in setting and adjusting, of promptness in removing finished work and supplying new, of anticipation of conditions soon to arise and preparation for them. The difference between turning or milling ten pieces or twelve is *not* twenty per cent. more muscular force expended, with a like increase in bodily fatigue and brain fag; it is more likely one of greater attention to securing properly sharpened tools from the tool room, to care in setting them, to the use of the machine at the best rate of feed and cut, to foresight in arranging for supply of new blanks or castings, and to the avoiding of delay from the inability to secure the helper or the use of the crane at the proper time. No one can go through a modern shop without being impressed by the large amount of time which remains at the disposal of the average machinist of to-day, free from engrossing care—free for the cultivation of his skill by study of his work with a view of improving his tool or the method of using it—free even for broader and less-specialised mental cultivation, if he prefer it.

It is certain that industrial evolution is not going to stand still at its present phase. More product, and better product, at less cost per unit is the invariable law, whether the product be breadstuffs, transportation, or the manufactures of the workshop. If this be a goad, then manager and man alike must work under the goad. The industry or the shop which best fulfills this inexorable requirement will thrive, and in its prosperity will furnish profitable employment to the most workers; the establishment, the institution, or the country which fails will be overcome and will die. And no effort to eliminate the individual and reduce all to uniform mediocrity, amiable as its motive may seem, can hope to prevail.

We are passing through an era of astonishing mechanical development. New machinery demands—and irresistibly demands—new methods of management. At every point of introduction, labour-saving machinery has met precisely the opposition which is voiced in Mr. O'Connell's paper. In every such contest, without exception, that opposition has gone down before the inexorable logic of necessity. So it must be with the piece-rate system—with every new system which marks an improvement over the old. "The survival of the fittest" is the inexorable law—in methods, as well as in mechanics.

PIECE-WORK NOT NECESSARY FOR BEST RESULTS IN THE MACHINE SHOP.

By James O'Connell, President International Association of Machinists.

I KNOW of no more discordant or unpopular note to strike in the whole gamut of economics than that of piece-work. Cover it up as you please—call it what you will—if you introduce the subject at any meeting of workingmen called to discuss labor economics, it has the same effect that a red flag is popularly supposed to have upon a mad bull. If there is any tendency manifested to go to sleep, introduce the subject of piece-work. The most somnolent become wide-awake, and the gathering that a few moments ago was placid as a mothers' meeting has become a pandemonium. There is never any variation. It has always the same effect. It is not a popular subject; it never will be so long as those who have experienced its baneful results are alive and able to bear testimony against it. I was never more convinced of this than I was at the last convention of the International Association of Machinists, which was held in Buffalo, N. Y., in May of last year. Nor have I required any further evidence than was there presented.

The premium system, as advocated by Mr. Norris,* was at that time receiving a great deal of attention both in the ranks of labor and among the manufacturing employers. I had been in correspondence with the gentleman upon the subject, and felt at the time that if the plan advocated was honestly tried and its promises honestly lived up to, it might prove of great value in reducing the friction that always asserted itself when anything in the nature of piece-work was hinted at. Imbued with this idea, I proposed that Mr. Norris' plan be endorsed temporarily; that it be given a fair trial, and if found to do all that its originator claimed for it, that no organized antagonism from our organization should check its progress or usefulness in the future. Then the storm broke. And it was not an ordinary one—it was a cy-

* The history of this particular instance, which is cited by Mr. O'Connell as a "leading case," was fully written in THE ENGINEERING MAGAZINE by Mr. H. M. Norris, in his papers on "Actual Experience with the Premium System" appearing in the issues for January and February, 1900. Those who are interested are referred to these articles for additional information.

clone. When the storm blew over, Mr. Norris' premium plan—or rather the motion to endorse it—was beyond resuscitation.

Many pitiful tales were told of similar fair promises that were only made to be broken; of harmonious relations that existed between management and employee—of fraternal intercourse of shopmates that prevailed before the introduction of the piece-work blight, and of the rude awakening that came when too late to check the insidious disease; of the greed that it awoke and encouraged in the most unexpected places; of its immoral tendencies—its promotion of discord and demoralization; of how it warms to life the cupidity that seems to be latent in the most seemingly perfect of natures, and of how it created an ishmaelitic like doom for all who were changed by its blighting influence—one man's hand raised against the other—in a fierce competitive struggle; of how the most generous-hearted of shopmates became the most penurious, and how the peculiarity was developed that characterized the horseleech's daughter—a desire for "more"—in men who had never before shown any symptoms of the miserly instinct. All this was told, and told in a way that carried conviction, for it was told by men who knew of what they spoke—men who knew by sad experience.

Now, I had submitted my report to our subordinate lodges, as our local branches are called, some weeks before the convention, and in my report I had entered very fully into the premium plan. I had published it in its entirety as it had been given me by Mr. Norris, so that all the delegates were thoroughly posted on the subject. Not only were they posted themselves, but they represented and reflected the majority thought of their constituents. In introducing the subject I had said:

"One of the most important matters to be considered by the delegates to this convention is the question of piece-work. There is no denying the fact that piece-work and the premium plan are constantly growing in our trade. Although we have succeeded in instances in preventing the introduction of piece-work, yet its volume is increasing. It is useless for us to any longer refuse to squarely face the matter. There is no one who believes more firmly than I that piece-work is detrimental to our trade; it not only works injury to the tradesmen, but results disastrously to the employer.

"We allow our members in some shops to work under the system; although the same firm may own the shop across the street, our members cannot accept the system there under our constitution. When we go to employers with this state of affairs existing we are placed in a most ridiculous position.

"During the past two years we have spent more money and devoted more time of the officers to the question of piece-work than to any other portion of our trade.

"A new plan is now being tried in some localities which, in the main, does away with the old practice of piece-work, and introduces what is known as the 'premium plan' of paying for work performed. This guarantees to the men that they will receive their regular wages whether the same is made by them or not."

(Here I quoted Mr. Norris' plan.)

"The delegates to this convention will fully appreciate that some definite action must be taken as to our position in the future regarding the introduction of piece-work and premium plans. In my opinion, it would be the wiser policy for us to face the inevitable, select the best system, then control it. I am satisfied if this is done we can rapidly unionize a large number of manufactories which we are now constantly fighting."

It will be seen by this that the matter had had the opportunity of being thoroughly ventilated and discussed in the locals prior to the convention, and it was not the individual sentiment of the various delegates that was expressed, but the concentrated opinion of the International Association of Machinists. There was a special committee appointed to report on this special part of my report and they reported as follows:

"Recognizing the great inroads that the premium plans and the two-or-more-machine systems are making into the machine shop of the present day, we believe it is essentially necessary that legislation of a definite nature should be enacted whereby the International Association of Machinists can successfully manage and control them. We realize that to further combat the system of premium plans will be suicidal on our part when we consider the fact of the many members of our organization being engaged in them at the present time.

"Your committee realize that this is a knotty problem to solve in presenting a plan whereby we can successfully deal with this question on the start. We do believe, however, that the plan herewith submitted will, in a measure, serve as a guide wherever the system is in operation, or may be introduced in future. We might also add that practical experience is the greatest teacher in all things, and during the next two years we will get the benefit of it, at which time we will be better able to amend or improve the plan herewith submitted.

"Members of the International Association of Machinists can accept premium work under the following conditions:

"First. That each employee shall be guaranteed his regular day's-work wages.

"Second. That the time limits shall never be lower than the average time made with the same tools under the day's-work plan.

"Third. That no one shall be discharged because of failure to reduce his time below the limits.

"Fourth. That, in addition to his regular wages, each employee shall be paid one-half of his regular hourly rate, for each and every hour he may reduce his time below the prescribed limits.

"Fifth. That the limit, once fixed, shall not be lowered except through the introduction of new methods of doing the work.

"Sixth. That all the premiums shall be paid within two weeks of completion of the work, upon which they were earned.

"Seventh. That at the end of one year's time the plan will be withdrawn from all those not wishing to continue under it.

"Eighth. That, if withdrawn, the employee shall not be required to work at the same rate of speed without an equivalent in wages.

"Ninth. Any member of the International Association of Machinists working at the premium-work system shall not be permitted to earn more than 10 per cent. in excess of the average wage paid in that locality. Shop committee shall ascertain each day the amount earned by each member under the premium-work system. All over 10 per cent. he may earn shall be forfeited to the lodge of which he is a member, and report same to the Financial Secretary of the lodge."

The report was unanimously rejected, or practically so, in spite of the fact that its favorable reception was advocated by the committee, and from the published proceedings I cull the following:

"The President then addressed the convention, saying that after great study he felt that it was his duty to bring this matter up, as the manufacturers of the country are making strenuous efforts to introduce the piece-work system. He then explained the difference between the piece-work system and what is known as the premium plan. He reported several interviews with firms, and advised the convention to adopt some law that would allow the officers of the International Association of Machinists to cope with this evil. He referred to the article of Mr. Halsey, editor of the *American Machinist*. Said he hoped some means would be devised to regulate this system."

But the storm to which I have already alluded was on, and the plan was swept aside.

The thing that struck me with the greatest force was, that no matter what scheme is proposed in the way of so-called profit sharing, it

is an impossibility to get it accepted with anything like unanimity by the workers, so long as their experience of piece-work is more than a memory. And any scheme to be successful must be accepted voluntarily; it must not be forced. If it is, it will be futile. Coercion, at all times and in all places, will prove abortive; the more you force obedience to any system that is as antagonized as the piece-work system is, the less you will have of it, the less the chances of success.

Its enforcement will breed disorder in any shop, whether the employees are members of a labor organization or not. If they are, they will offer organized resistance, in which they will be in receipt of the sympathy and assistance of their fellows elsewhere; if they are not, they will degenerate into a species of serfdom without any of its redeeming features.

There is another thing in connection with piece-work that is not generally known by the employing manufacturer—if it is, I have never seen anything to show it—and that is, with the introduction of piece-work in the present well organized condition of the trade, would come some form of limitation of production. There is no limitation of production now, nor has there ever been to my knowledge, official or otherwise; but if the piece-work principle was successfully enforced—and it could not be without great loss to both employer and employee—the trade union would be driven to adopt some measure of retaliation and protection, probably similar to that adopted by the Amalgamated Society of Engineers in Great Britain. And so much fear has been expressed lately that the trade union would decree how much work a man should turn out in a day, that I think this view of the situation is worthy of consideration by those in whose ideas of successful superintendency is included the introduction of piece-work.

Over a quarter of a century ago the Amalgamated Society of Engineers recognized the great possibilities for evil that existed when a man's selfishness was tried by the piece-work system of ethical education, and counteracted it by the following law:

"Any member taking work by the piece, and not sharing equally, in proportion to his wages, any surplus made over and above the weekly wages paid to members and other persons working on such job, shall be summonsed, etc." Then follows the penalty for violating this law.

Then to stop connivance—supposing the management was not above that sort of thing—on the part of a timid man who might be afraid of losing his job if he stood out for his share of the surplus mentioned above, the following was enacted:

"Any member working for or under a piece-master, and not receiving an equal share of any surplus in proportion to his wages that may be made over and above the weekly wages, he shall be summonsed before his branch * * * and, on his refusal to leave such employment, he shall be fined in the first instance twenty shillings ($5) and for the second offence excluded."

Rather drastic means to inculcate unselfishness, but at the same time, I have no doubt it was meant to teach discipline as well. At present, I am led to understand, no member of the Amalgamated Society of Engineers is allowed to earn more by piece-work than thirty-three and a third per cent. over his daily wage, or, as they put it, equivalent to time and a third. If laws like these are detrimental to the interests of the employer, piece-work, and piece-work alone, is responsible.

This way of looking at piece-work may appear sentimental to some, but the principle is strongly condemned, and has been, by eminent sociologists who have made a study of the labor problem. Condemned on the ground that it encourages over exertion, overtime, exploitation, and the sweating system. In some trades it enables employers to hire more help than they require. That tends to uncertainty of employment, a surplus labor market, and the consequent ruinous competition of the unemployed. For it is an undisputable truism that the man out of a job—the man on the street—dictates what wages shall be paid. When one-half of the laboring community does the work of the whole, the employers of labor make use of the redundant labor so created, to compel those who are employed to work for less pay.

This may be considered the ideal state by the employer of labor, but the employee thinks differently; hence the rooted antipathy to piece-work, no matter in what guise it appears.

Perhaps it might be asserted—and with a certain degree of justice (but only a slight degree as I will show presently)—that the universal introduction of piece-work into the machinists' trade could never give the employer of labor in that particular calling an opportunity to hire, or keep hanging on in hopes of a job, more help than could be permanently employed. This assertion ought to be accepted without question if nothing was ever produced except what was ordered by the consumer; but the whole trend—the very essence—of modern production, is to accumulate a surplus—to make stock—so that any sudden demand can be furnished at once. Whenever a manufacturer starts on stock he has the opportunity, should he feel so disposed, of creating a labor surplus. I have known this to occur, and the employer to pose

as a philanthropist while doing so, making the plea that there was no demand for the product, though out of the goodness of his heart he was making stock so that he could give employment to the men—*at reduced prices.* Of course, his certain hope of an eventual market had nothing to do with his philanthropy.

Aside from this, even were it not so, the trade-union movement endeavors to overthrow, or at least to minimize, existing evil conditions wherever found; and knowing that this evil exists to a lamentable degree in other crafts, it is denounced by ours.

Take the garment workers for instance. Piece-work to them has meant, and does mean, degradation. It furnishes an example of how the employer is enabled to partially employ double the number of people that are required to produce his output, so that he is enabled to use one-half of those he employs as a club to beat the other half into the acceptance of any piece-price he may feel disposed to offer. Piece-work, in this case, creates the bitterness of uncontrolled competition between workmen, and has intensified the bitterness of the struggle for bread. The conditions of life, which were not too roseate at any time for the garment worker, have become worse than they were and more deplorable, through the piece-work evil. Because of this immoral tendency, we are opposed to piece-work on principle and will never be a willing party to its propagation. Trade unionists are not alone in this. An awakening society echoes every word of bitter protest that has been said against the rigors of this devouring system. The organized portion of the machinist craft can never be pointed at, if they can help it, as being a party in sympathy with an evil that has demoralized any wing of the army of labor. We will not accept anything, either by countenance or approval, that is degrading, or tends to the degradation of the worker.

I have often asked myself whether the average American machinist really requires a goad to make him do a day's work, and I have honestly come to the conclusion that he does not. He has been so often told that his brother in Europe worked so much harder than he, that he has finally accepted the statement as a fact, and keeps up the high pressure at work, which, along with his skill, is his chief characteristic. I used to believe the same thing. But I now know that both he and I were misinformed. The British machinist—or engineer as he is called—does not work so hard, nor does he make any pretence of doing so, as does his brother mechanic on this side of the Atlantic. I know whereof I speak, for I made a very careful study of the question last summer in England, Scotland, and Ireland.

I do not know anything of the conditions on the continent of Europe from personal observation, but I do know that, no matter what these conditions are, and no matter what speed the continental workmen manage to keep up, nor how many hours a day they labor, Great Britain successfully competes with them in the machine markets of the world. This being the case, I have come to the conclusion that a goad is unnecessary to drive the average American machinist.

But, though a goad is at this time unnecessary, the time has come when a stimulant would not be an injury. The long, many, and tedious hours of toil, and the high pressure at which he has worked, are bound sooner or later to assert themselves, and his productive power will not be so great as formerly, just the same as the enervation of age tells upon a man's output now. Then it will be necessary to provide a stimulant to keep up the admirable *esprit de corps* that has made the American machinist and his product the wonder of the world. What shall the stimulant be?

First, we must find out what effect a reduction of the hours of labor by one hour per day would have. Then he must be taught that the employer has at last come to the conclusion that the possibility exists that he—the employer—may not always be right and that the employee may not always be wrong—that there is a possibility of mistake and misunderstanding on both sides which might be amicably adjusted if they met with mutual patience and respect.

Then we must find out how he lives and where he lives—in what numbers and by what chances; if his life is monotonous we must see that the monotony is varied; there must be no more sameness—he gets enough of that during his working hours. He requires sunshine as well as shadow, and we must see that he gets a generous share of it. We must treat him as a man—a man with all the hopes and joys, the fears and responsibilities, of manhood. We must cease to talk of him and write of him as if he were a part of the machine he manipulates. And we must not do anything that would retard his progress or reduce his standard of living, for both are necessary to the prosperity of employer and employee.

Let us stimulate him in this way and he will require no goad, other than his awakened and newly appreciated intelligence, to produce to his full capacity. Do this, and the peaceful methods of evolution will succeed in benefiting all, where the barbarity of piece-work created chaos. Do this, and both workman and employer can achieve all their desires without having recourse to any measure or system that is repulsive to human nature and disastrous to their mutual interest.

THE ELECTRICAL EQUIPMENT OF THE TALL OFFICE BUILDING.

By Reginald Pelham Bolton.

BY the term "office buildings" must be understood the largest class of buildings for which New York City has become noted, and which, by reason that many of them stand on restricted areas, have been extended in the vertical direction to considerable heights, and are thereby familiarly known as "sky-scrapers." The electrical problems therein are directly due to the two features of magnitude and altitude.

Such buildings are indigenous to America, but the interest which their construction has aroused in Europe, and especially in London and Paris, may be expected to lead to the adoption of some of the methods which have been developed in order to meet the novel conditions they have demanded. Further, the electrical equipments in such very large buildings exceed the proportions of usual private installations and compose a new class more of the nature of small central stations, serving, as they do, a body of residents equal to that of a small town, with a transient traffic running into thousands. With the public central supply, therefore, the tall-building equipment comes into sharp competition, and since the demand for such equipments may be expected to spread wherever business demands the office-machine or modern business-building, the comparison of their economies should be of interest in many communities.

While the lighting of such buildings is required by modern demands to be electrical, it has been, and may to some extent continue to be, a consideration open to considerable question whether the electrical method can be extended with economy to the operation of the elevator service. The arguments for this extension are condensible into the following, but the facts which the experience of the past few years have demonstrated, and which should be properly weighed to decide this important matter, are not so readily stated, yet when stated will be found to bear strongly against the extension.

It may be asserted that electrical elevators are more economical *per se*, that a further gain is obtainable by operation in conjunction with lighting work, and that the generating plant required is the

additional cost of a single generator unit; also, that there is a general advantage in the combination of all services under one character of power; finally, that the service can be operated by outside supply without the expense of installing a generating plant.

These assumptions have been the cause of much disputation, and in a number of cases where incompletely studied have led to decisions in favor of the adoption of electrical operation of elevator machinery. The results of the use of the electrical high-speed machines are now before us and can be briefly summarised as follows:

Without the addition of a storage battery, the high-speed electric elevator is not so economical as the hydraulic.

The additional cost of a storage battery, with interest and depreciation thereon, outweighs any economic gain obtainable.

Without a battery, the service cannot be combined satisfactorily with lighting work.

A higher class and greater extent of labour is necessary with electrical-elevator machines.

The cost of maintenance and repairs is largely in excess of the same items with hydraulic machines.

The cost of outside electrical supply is too great to admit of economical consideration in this class of building.

The reason for this disappointing result, to my mind, is to be found in the basic fact that this service is a radically unsuitable application of electricity. The irregularities of the service are extreme, much more exaggerated than those of any surface railroad. They are illustrated in the following diagrams of fluctuations of a five-elevator and of a six-elevator service.

If this fluctuating service were necessarily conducted at large or varying distances from the source of power, the electrical method might, and probably would, exhibit superior advantages, as is the case in trolley service; but in elevator service the generator and the application are so closely connected that the question of friction scarcely enters into account.

Storage of power, or reserve force, is obtained in a much cheaper form in the case of hydraulic power than is within the range of probability in the electrical. A pressure-drum suitable for a five-elevator plant costs about $850, and with piping and appurtenances the storage will not cost more than $1,500, while an electrical storage battery to accomplish equal results could not at present be purchased for less than $12,000. The life of the hydraulic storage is practically unlimited, certainly not exceeding a depreciation of 1½ per cent..

while a battery must be debited with a depreciation account of not less than 7 per cent. It is probable, therefore, that the attempt to operate schedule elevator services by electricity will not extend much beyond the cases already installed, except in instances where some possible special desirability of the operation by outside electrical supply, for night service, or for breakdown, is considered to outweigh the addition of operating cost and maintenance.

Passing to the consideration of lighting work in these buildings, the problem by itself becomes rather a simple one. The extent of lighting is increasing, but is still subject in large degree to the vagaries of architects, whose system in this matter, as in others relating to engineering subjects, is largely to copy the errors of their own previous efforts or those of others which appear to them to present parallel features. Thus it has happened in numerous cases that large additions to lighting loads have had to be added after the building is filled with tenants, while in others the unnecessary multiplication of lights has led to a permanent cost for useless current.

The location of outlets is a matter in which technical experience and study are well repaid, and while the former may direct much of the arrangement, a consideration of each office room is required to reach a proper decision as to the probable position of furniture and light. Many buildings also are liable at some later period to lose a large part of their outside light from the erection of other tall neighbours, and in nearly all cases that part of the light which is obtained by windows in the party-wall (commonly known as "stolen light") is liable to entire closure, in which case certain rooms will in future be entirely dependent on artificial illumination. When all these points have been decided, the outlets should be arranged so that they take corresponding positions on the respective floors, forming practically similar installations on each floor.

In such a case the "vertical" arrangement of wiring, which I designed for the Bowling Green offices of 3,200 outlets, is a means of great economy in first cost as well as of advantage in construction and maintenance. In this method the circuits are run up the line of corresponding outlets connecting to distribution centres in the cellar. The distance between outlets is thus reduced to the height of one floor, whereas in the ordinary system the average distance apart would be not less than one-fourth of the extent of walls or partitions of each office. The precise effect is best appreciated by the reduction in cost, which experience in several installations has shown to be not less than 30 per cent. in favour of the "vertical" system.

There are incidental advantages to be added, such as the absolute drainage of the vertical conduit pipes and the concentration of fuses and switches in the engineering space. For the above reasons it is not practicable to give a definite figure of the amount of lights or the relation of number to floor area usual in this class of building, but some comparisons may be made from the following:

	Inhabitable area.	Contents.	Lights.
Bowling Green Offices.	247,000 square feet	4,915,000 cubic feet	6,300
R. G. Dun Building...	99,000 square feet	1,250,000 cubic feet	3,800
German-American.....	78,000 square feet	1,330,000 cubic feet	2,000

The character of the lighting load is peculiar, and consists of a very light day load, with a sudden but short evening load averaging 70 per cent. of the maximum, and with infrequent but abrupt maximum loads during day darknesses, such as those preceding sudden thunderstorms and still more rare days of dark fog. For such work a division of the generating units into three usually best meets the requirements; and, preferably, three units of unequal sizes. The very short period of heavy load is such that I have not found any obtainable economy in compounding the cylinders of generators.

The security and desirability of a storage battery has to be considered, and its cost compared with other methods of security and economy. As regards the former, it may well be conceded that the insurance against breakdown afforded by a storage of power outweighs considerations of cost, and conditions are to be found where this feature will decide the adoption without further consideration.

In considering the question of economy, the storage battery suffers always by reason of its large prime cost, to the interest on which must be added the known rate of maintenance. In the lighting only of office buildings it does not gain by any reduction of labour, and is further at a disadvantage by reason of the demand for waste steam for heating purposes during the winter season.

Although in connection with elevator service it is essential and its economy over direct operation is unmistakable, for lighting work it can be credited only with the saving of one generator in cases where the plant would otherwise require three, since two are necessary to maintain the standard of duplication generally adopted for purposes of security in office buildings. There may also be an economy in the cost of any outside supply of current, which may with a battery be taken at the lowest rates, when proportioned to be charged during hours of light station loads. But, inasmuch as the lowest present rate of station supply is largely in excess of the cost at which

equal supply can be generated in the building, there is little advantage to be gained by this service, other than as affording some additional security.

The usual tension employed at the lamp is under 120 volts, but there has been considerable recent discussion of the desirability of the adoption of a tension of 220 to 240 volts. In favour of such an increase in tension is first, the uniformity of system where motors are employed, these being practically standardised at the higher voltage —and secondly, the reduction in copper and in size of conduits. As the latter item, which is not considerable in these buildings, is outweighed by the reduced efficiency of the higher-tension lamps, the consideration filters down to the desirability of uniformity, which, in the case of the installation of electric elevators, becomes of sufficient weight to justify a decision in favour of the higher voltage.

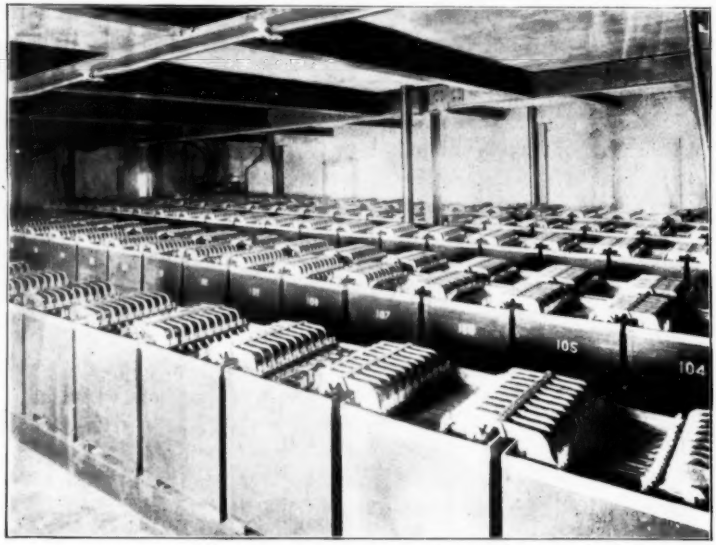
The outside supply service in New York being three-wire, the arrangement of straight two-wire feeders and circuits does not conform to the desirable division of the load of a large building on the two sides of the three-wire system, and the load must be sub-divided to some extent at the switchboard.

The 220-240 volt lamps are now greatly improved, but there remain some small troubles with fuses and circuit breakers which have to be overcome.

The assertion that, under office-building conditions, the generation of electric supply can be made more cheaply than by outside supply companies, has been contested by the champions of centralised electrical generation but cannot be controverted; and the best answer to their arguments is that I am prepared to show that a number of office buildings can afford to sell current to the illuminating companies during their hours of maximum night load and entire day loads. I have had before me the figures of a number of office buildings, and in all the cost of electrical generation is very much lower than the lowest rate of outside supply, and it may be concluded that until current can be supplied to such buildings during the hour of maximum load at less than two cents per kilowatt hour, it will not enter into competition with the internally-generated supply.

To accomplish this result, I take the view that the supply companies must themselves provide, as part of their system, storage batteries of such proportions that their charging may be done at the hours of lightest station load only, and they must dispose of their waste steam at a certain value, or provide its value to this class of building in the shape of reduced cost of electrical supply.

The storage battery has for years struggled against the adverse circumstances of costly material and limited use. It is the power-supply companies to whom the battery presents the largest source of advantage, and it is their wide application of it at storage points to meet individual requirements that will eventually produce the demand which will operate to reduce the cost of manufacture. It will



CHLORIDE BATTERY, R. G. DUN BUILDING, NEW YORK.

not suffice merely to install batteries at the central station—they should be feeders to all dead ends of the supply system. With such a system widely enough adopted, the average load line of a central station might be raised to the economical heavy load during the entire day and night, and such an increase of output would enable the service to be sold at competitive rates during all but the winter months.

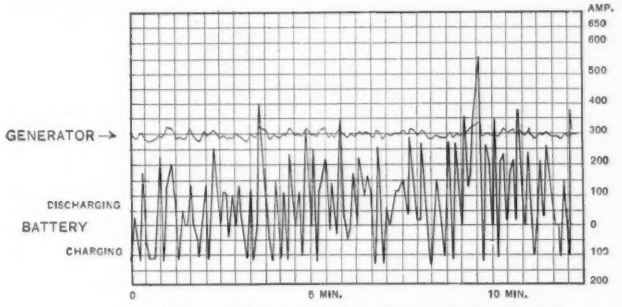
An instance exists in the case of the large battery in the Bowling Green building, belonging to and operated by the New York Gas, Electric Light, Heat & Power Co., which is charged from the Duane Street central station during hours of light load, and feeds its district during the same time, at full pressure, helping to maintain this service and pressure by discharging in parallel with the station during hours of heavy load. Incidentally it supplies the Bowling Green offices in which it is situated at the rate of 4½ cents per kilowatt

hour, but as it happens to pay rent for space occupied a comparison in this case is not conclusive. Assuming, however, a building having about 4,000 lights and adopting the supply of an outside company:

The first cost of an electric plant would be	$12,000
On this, depreciation, repairs and interest amount to	1,160
Labor and sundries	1,640
Total directly chargeable to cost of electric supply	$2,800
The yearly electrical service would amount to about 181,500 kilowatt hours, which the building could generate for about 450 tons of coal, say	$1,350
Add interest and labour account	2,800
	$4,150

Of this, part of the coal represents useful work done for the heating of the building, but even making no allowance for this purpose, the cost is near 2¼ cents per kilowatt hour. To purchase this supply at 4½ cents per kilowatt hour would cost $8,167.

As the standing charges would not be increased if the generators were run full load all day, the building could well afford to sell current for the cost of coal, of partial interest and depreciation, and some profit, which could, therefore, be done at a rate not exceeding 2 cents per kilowatt hour.



ELECTRIC ELEVATOR LOAD WITH BATTERY

AN ILLUSTRATION OF THE FLUCTUATIONS OF DEMAND OF A SIX-ELEVATOR SERVICE.

R. G. Dun Building, New York. The variations are carried by a storage battery, resulting in practically uniform load for the generator of 100 k. w. capacity (420 amperes at 240 volts).

If the work of heating could be taken up by the supply companies, a different complexion would be put upon the figures discussed, and

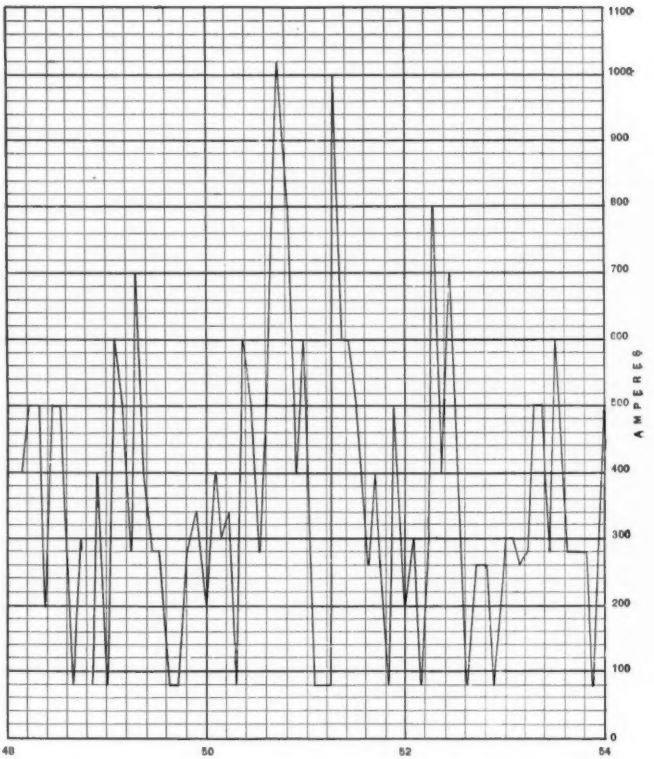


DIAGRAM OF FLUCTUATIONS OF LOAD DEMANDED BY FIVE ELECTRIC ELEVATORS.

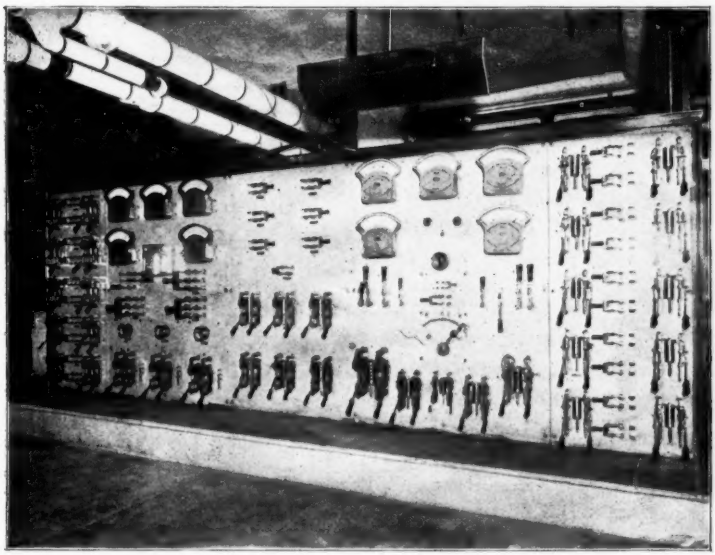
Carried by direct-connected generator of 100 kilowatts capacity (800 amperes at 125 volts). Lord's Court Building, New York.

an overwhelming addition be made to the adoption of central-station energy. This is only practicable by the utilisation of the waste steam of the station, when a product now practically useless would become a source of profitable income, and, as a combined proposition with electric supply, could be made to compete so far with an independent plant that the majority of owners of this class of property would find its adoption of advantage.

They could afford to pay for the combined services a sum equal to their coal bill, the interest, depreciation, and repairs on the entire

plant, and all of the wages account excepting that of, say, one engineer and an assistant.

In the case of such a building as referred to above, the general cost of operation for elevators, lighting and heating, and house pumping service for a year, including interest and depreciation, will amount to $10,970. If operated as suggested, this is all that the owner can be expected to pay, and for this the supply company must provide:



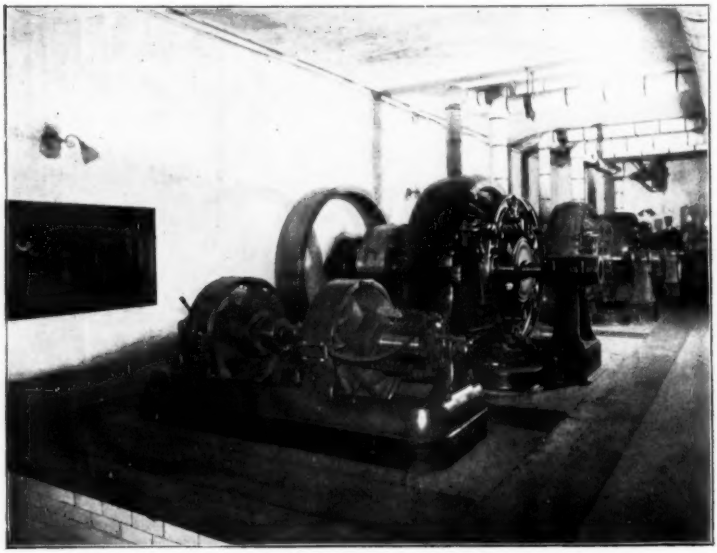
SWITCHBOARD OF THE R. G. DUN BUILDING, NEW YORK.

For elevators, lighting, and battery; three generators, booster, and supply company's connections.

Elevator service	135,000 kilowatt hours
Light	181,000 kilowatt hours
The equivalent, in steam, of	4,200,000,000 B. T. U's
Wages one engineer and assistant. These four items must not exceed:	
Elevator service at 2 cents	$ 2,700
Lighting service at 3 cents	5,430
Waste steam at 34 cents per million	1,428
Wages	1,412
	$10,970

Not until these rates can be afforded with a profit in the sale will independent plants in office buildings cease to enter into competition with the central station.

The interior economy of the organisation of large central-supply companies is not an open book, but it is evident that, even if most economically managed, the secret of their inability to compete with well-proportioned independent plants lies in the large standing expenses which they are compelled to maintain for the purpose of

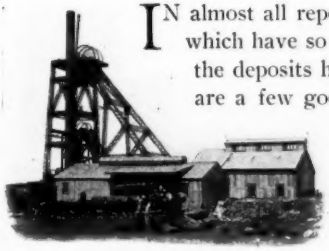


LIGHT AND POWER GENERATORS, AND BOOSTER FOR BATTERY CHARGING.
R. G. Dun Building, New York.

supervision, inspection, clerkage, collections, banking, and in the interest and depreciation of their extensive and expensive systems of underground mains, none of which enter into the cost of an independent plant. Therefore, until their business is so large and so economically administered that the proportionate part of these expenses, which must be charged against each consumer, is less than the interest and depreciation transferable from the owners' little plant to the station-plant conduits and pipes, and that part of his small wage account capable of transfer to the central-supply station can be utilised to produce there equal or more productive work—so long will the central supply suffer in comparison with office-building economies.

DUTCH GUIANA FROM A MINING STANDPOINT.

By J. Esdaile Florance.



IN almost all reports of gold placers in Dutch Guiana which have so far been made current, the wealth of the deposits has been vastly overestimated. There are a few good properties which, in the hands of experienced mining men, can be made to pay. At the time of my visit none of the placers was in operation, owing to the unusually dry season, which was remarkable even for that country, no rain in sufficient quantities to be serviceable having fallen for nearly a year. There are so many difficulties to overcome that it is advisable for capital to be extremely careful of mining investments in the country. The intense heat, the surety of malarial fever in its worst form, labour, which is extremely difficult to obtain and control owing to the peculiar laws governing miners, the extreme difficulty of transportation—all must be given due consideration, and will be referred to further on.

I reached the country by steamer from New York to Grenada, proceeding thence by Dutch steamer Wilhelm IV. via Port of Spain and Demerara to Surinam. Port of Spain is singularly beautiful, situated among fine hills. The Queen's Park Hotel is the most magnificent of any in that part of the world, and is surrounded by tropical trees, plants, and flowers; opposite to it are the golf links, cricket grounds, and the governor general's mansion, where the regimental band gives afternoon concerts. There are but few whites, and those who are there are English. There is, however, a large foreign population—coolies, Hindoos, Javanese, Japanese, and many other nationalities wearing their native costumes. Demerara, being settled by the English, is more like one of our own towns and hence less striking to a stranger.

Dutch Guiana or Surinam is a colony of Holland. It is situated on the northern Atlantic coast of South America, occupying, with British and French Guiana, the territory between the Amazon and Orinoco Rivers. Paramaribo is situated on the Surinam River and is the chief seaport. There are a number of fine cocoanut and sugar plantations at this place whose products, in connection with the fine

A SECTION OF A GUIANA PLACER MINE

tropical fruits, furnish the principal source of revenue. There are some very handsome residences, and the governor's palace is situated facing a large square. Sunday afternoon the band concert draws a remarkable crowd, most interesting to the stranger, as all nationalities are represented. Handsomely dressed ladies may be seen walking behind bush negroes in their full dress, consisting of a freshly oiled body and a breech-cloth, the principal part of their decorations being their hair, which is wrapped with twine and stands up all over their heads like the quills on a porcupine. They are a magnificently developed race of men. The Javanese, Japanese, Chinese, coolies, Hindoos, native negroes, and in fact all the globe is represented, but at first glance one would imagine he was attending an unusually fine circus parade.

The organisation of the expedition party, which consisted of a Dutch foreman and fourteen native negroes, consumed six days. We left Paramaribo in a steam launch chartered for the occasion, taking in tow a fifty-foot fishing boat, with provisions and baggage. There were also, on our launch, two Dutch engineers and eighteen men who had asked our permission to share the launch and who were going further up the river, representing the Company Surinam, who have

large concessions from the Dutch government in consideration of their agreement to build a railroad through the virgin forests of Dutch Guiana. It is to be noted that, upon the failure of any of the natives to meet their annual taxes on mining property, the property reverts irrevocably to this company.

Boschland, the point at which we left the Surinam River, is about sixty-five miles from Paramaribo. On account of the extremely low stage of the water we stuck several times on sand-banks, finally abandoning the launch when about two-thirds the distance had been accomplished and taking to our boat, which was rowed by six men using sweeps. The Dutch engineers got into a large canoe, their men using paddles, the crews of both boats, singing their native songs, each vieing with the other to obtain the lead. This lasted for some time, when we stuck on a bar and the Dutch party, having the lighter boat, left us.

After repeating our experience with the sand-banks innumerable times, we finally arrived at Boschland about six o'clock in the morning. This point is a Dutch government police station and is situated on a bluff standing about twenty feet above the river in the dry season, though I was informed that in the rainy season the river often overflows its banks. Our men were too fatigued with their exertions to attempt anything further that day, so all hands rested. The next day

PORTION OF GROUND WASHED FOR PLACER MINING.

the men went into the bush with two weeks' provisions, carrying about fifty pounds on their backs in a kind of knapsack made of twisted bush rope, which is used altogether in that country to take the place of twine and heavy cord. It hangs in large quantities from the trees and is, of course, a great impediment to progress through the bush, as, unless you continually use your cutlass to clear the way, it becomes entangled in your feet and is of sufficient strength to trip you. The following day the men came back for another load. The next morning the owner of the property, the promoter, and I started for the camp at seven o'clock. After crossing fifteen hills from two hundred to five hundred feet high, some of them extremely steep, we arrived at three o'clock in the afternoon, very much fatigued by the walk, on account

PIPE LINE TO THE RESERVOIR OF A PLACER.

of the intense heat. We sent part of the men back for freight, and started the rest of them at building a camp.

Upon walking over a portion of the property, I found a great scarcity of water. The creeks, so far as investigated, show indications of having been very thoroughly worked. The question confronting us was whether or not the gold extends back from the creeks. I saw no indication whatsoever on this property of quartz lodes. I started to make a thorough examination, with the result that pannings occasionally showed small indications of coarse gold, ranging from two grains to thirty-eight grains. After putting down a number of pits on the side of the creek, I found about five feet of alluvial soil, one foot of clay, and from eight to twelve inches of the so-called pay gravel, which

consisted of a very tenacious clay, pieces of white quartz, and in some cases a small quantity of iron-stone. In all my examination, in only one pit did I find sufficient indications to warrant further investigation, and this was at a point where the creek made a turn and had been overlooked by the former operators. Having satisfied myself that the creeks had been thoroughly worked, and that it was evident that the report of the great richness of this property had emanated from this source, I undertook to find out whether there was any gold back from the creeks. This was accomplished by sinking a series of pits and, in one case, running directly back from the creek a ditch four feet wide, eight feet deep, and one hundred and twenty feet long. There a long tom was set up and, by means of an Edson pump which I had taken

RESERVOIR OF THE MULLER AND DE JONGE PLACER.

with me (and which I wish to recommend most highly for exploration purposes), I forced water which had been reserved in a dam for this purpose about seventy-five feet, and started to wash the dirt, with the result that we did not find even a trace of gold. As this was invariably the case in every pit put down away from the creeks, I found after two weeks that there was absolutely no use of continuing the examination. As a placer proposition the property was utterly valueless.

The ground is covered with heavy timber and the tropical vegetation of such density that it would take an engineer and a number of men perhaps a year or more to say absolutely there was not a quartz lode on the four hundred hectares, but so far as my judgment is con-

cerned I can say confidently there was not the slightest evidence that such was the case. The samples of white quartz from the tailings when assayed show no trace of gold. How the white quartz got there is a problem which has puzzled all visiting engineers. The most valuable property in Dutch Guiana, at the time of my visit, was undoubtedly the Muller and De Jonge placer. In hydraulicking there they ran across a lode which apparently is of great value. I did not examine this property, as it was under bond to a Holland syndicate, but a number of photographs which are of great interest accompany this article. Mr. Muller showed me some wonderfully rich quartz taken from this lode at a depth not exceeding forty feet. In fact, I have never seen more beautiful specimens of gold quartz. The mineral reports of this property show that between 1883 and 1894 654,000 grammes, valued at $392,400, had been taken cognisance of by the government. They recently erected a hydraulic plant; on the first run of 159 hours, it is claimed, it produced 659 ounces of gold, valued at $11,862.

The managing director of the Surinam Bank told me, in course of conversation, that Mr. Muller had a short time previously refused $400,000 in cash for this property. The Von Hemert placer also pro-

HYDRAULICKING WITH GROUND SLUICES.

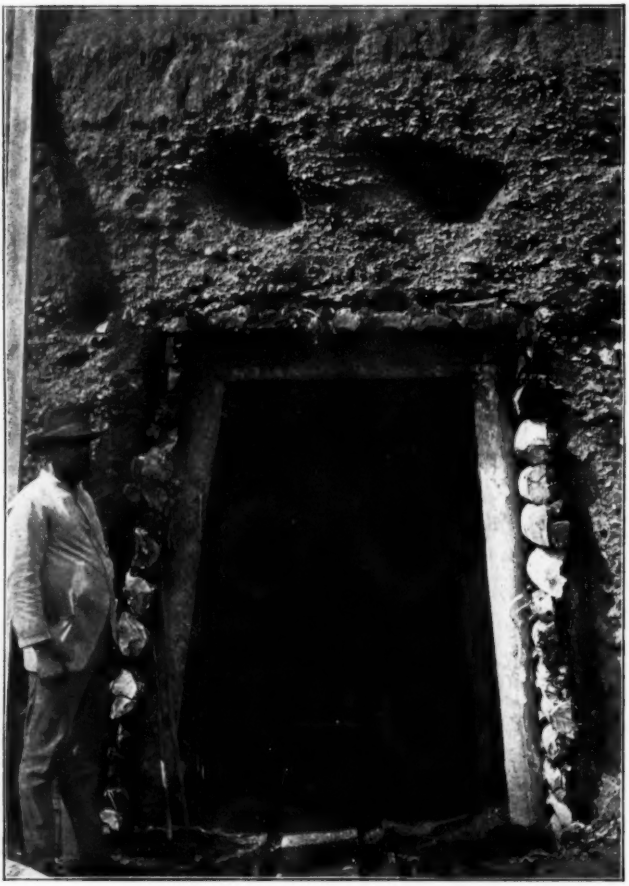
duced, between 1884 and 1892, 1,619,850 grammes, valued at $896,928.

The natives, who are mostly negroes, do all of the mining and the returns are made in small amounts from the creek washes and

aggregate quite a large sum during the year. These people, inured to the climate and living at a minimum of expense, with primitive appliances are able to make money where a company would be unable to do anything whatsoever.

HYDRAULIC PLANT IN OPERATION SHOWING GIANT, SUMP, AND ELEVATOR.

After a careful investigation, I am of the opinion that it is not advisable at present to invest in the country, although unquestionably, sooner or later, some rich lodes will be discovered nearer the mountains, which at present it is almost impossible to prospect. Grant that a prospector is fortunate enough to find a rich lode; the labour in itself is such a serious question that I am extremely doubtful if success could be made under present conditions. In the first place, it is necessary to advance two weeks' pay to the men and a contract is signed which apparently binds for an agreed time, but in fact is of little or no value, as upon taking them to the bush, if they claim sickness, the employer is obliged to send them to Paramaribo at his own expense. The government specifies their provisions, and the law favours labour as against the employer. Wages amount to about sixty cents American currency per day, and their food to about forty cents per day. One American miner can do more work than four of them, so there is really no economy, although on paper it would seem so. The climate at Paramaribo is quite healthy, there having been no epidemics for years, but upon leaving the river and going into the bush, the malarial fever in its worst form is inevitably met. Not a day passed that some of my natives were not laid up with it, and I was very seriously ill. The



ENTRANCE TO AN EXPLORATION TUNNEL.

water supply is another very serious difficulty, there being practically none for mining purposes during the dry season without an immense expenditure to bring it from the Surinam River; in the wet season, on the other hand, the river is completely out of its banks and everything is flooded out.

THE PARIS EXPOSITION AS A MECHANICAL ACHIEVEMENT.

By Edmund Mitchell.

INTERNATIONAL exhibitions, which are intended to illustrate and commemorate the progress of mankind in every country and in every sphere of industrial activity, must be themselves progressive. Each new venture of this description must beat the record established by its predecessors, or admit itself beaten. There can be no going back; diminished effort, diminished expenditure, diminished magnificence in the results attained, would be contrary to the spirit that animates the enterprise, and would spell inevitable failure.

Therefore, it has been with keen anxiety that France, and with sympathetic interest that the world generally, have been asking whether the city of palaces that has sprung into being on the banks of the Seine for the year 1900 is going to eclipse the vanished but never-to-be-forgotten glories of that other city of palaces which during 1893 shimmered, white and beautiful, on the shores of Lake Michigan. The task which Chicago set to any friendly rival courageous enough to organise the next World's Fair was a formidable one; but while the Exposition buildings in Jackson Park were still standing in all their dazzling splendor, Paris boldly accepted their silent challenge and announced her intention of playing hostess to the nations in the closing summer of the century. She has had seven years to bring the gigantic undertaking to completion; her guests and coadjutors are on the eve of pronouncing the verdict.

That Paris, with her matchless reputation for art and good taste, and her accumulated experience derived from four previous Universal Expositions, should come triumphantly through the ordeal depended perhaps less on material than on political considerations. The period of preparation has been a perilous one—one of bitter and continuous

The conduct of a great exposition is an example of works management on its hugest scale. Every problem of arrangement, equipment, power development and transmission, internal transportation, organisation, discipline and accounting appears at its maximum. From this point of view alone, the study is most important. Mr. Mitchell's article will be followed by a specialised treatment of the power features of the Exposition.—THE EDITORS.

internal dissension and of spasmodic threatenings of war. But the storms have been weathered, and the success of the enterprise is now assured. For there can be but one judgment pronounced—the Paris Exposition of 1900 surpasses anything of the kind the world has ever seen. To this result all the nations have generously contributed, not merely as a duty to themselves and their industrial producers, but as a sincere pledge of cordial feeling towards the French Republic. The United States, the friend of a hundred years; Germany, the enemy of yesterday; Russia, the ally of to-day; England, which unscrupulous mischief-makers would designate as the antagonist of to-morrow—these, and every other civilised country, great and small, have joined hands in securing for France her victory of peace. And all will unite in expressing the fervent hope that the Exposition, which, while yet in making, served the Republic at more than one crisis as excellent national ballast, will now, in being, still further bring down the load line and ensure continued and increased stability for the Ship of State.

Comparisons are proverbially not in the best of taste, but in the case of International Expositions they cannot be avoided. I have voiced the general opinion by saying that Paris in 1900 establishes a record; yet there are points for which Chicago is still entitled to retain her laurels of 1893. The charming landscape effects that were possible in the wide demesne of Jackson Park are unattainable in the detached and comparatively circumscribed areas that have had to be utilised in the French capital; even the silvery Seine cannot take the place of Lake Michigan's broad expanse of sunlit, rippling waters; and while the Champ-de-Mars may present a grander spectacle, it still leaves undimmed the memory of the chaste and classic architecture of America's Court of Honour, with the gleaming dome of the Administration building closing the one vista and the graceful peristyle that so perfectly completed and yet did not terminate the other.

But the relative disadvantages as regards site with which the organisers of the present Exposition have had to contend are, with consummate taste and genius, eventually made to contribute to the successful results attained. Paris itself is pressed into the service, and becomes an integral part of the Exhibition. Isolated spaces are linked together, and ribbons of gay buildings bind each and all into one harmonious whole. The Seine, that might have divided, becomes with its permanent and its temporary bridges an impounded waterway that most certainly ought to have been artificially constructed had nature left it out of the scene. The Eiffel Tower, which if a masterpiece of mechanical skill is none the less a hideous monstrosity, now seems

THE CHAMP-DE-MARS, SEEN FROM THE EIFFEL TOWER.

The uncompleted building on the left is the Palace of Mines and Metallurgy. The Chateau d'Eau, forming the façade of the Electricity Building, closes the vista. The ornamental chimneys over the boiler houses are on each side, beyond.

quite appropriately to look down benignantly on the younger and smaller brood of domes and minarets, steeples and belfries, that crowd around. The Palace of the Trocadero, admittedly the ugliest public building in Paris, at last is placed in a setting where it becomes a veritable thing of beauty, its twin towers dominating from the hill on which they sit the marvellous aggregation of Asiatic, African, and Polynesian structures that crowd the gentle slope of the gardens beneath. The crowning architectural gem of the French capital, the gilded dome of the Church of Les Invalides, under which rest the ashes of the great Napoleon, is made to close a superb vista formed by an esplanade between two Exhibition palaces that might otherwise have been constructed as one, a richly decorated court, the new bridge of Alexandre III. with its ornate statuary, and then the broad tree-shaded avenue that separates the two stately Palaces of Art. At the main entrance the vast Place-de-la-Concorde, with its monuments, its fountains and its Egyptian obelisk, has been left untouched; yet it

THE MONUMENTAL ENTRANCE

seems placed, proportioned, and adorned, all in accordance with design. The unrivaled foliage of the Champs-Elysées and of the Tuileries Gardens equally appear to be incorporated in the picture. Thus it is that Paris herself becomes a part of her Exposition, the perma-

nent and the temporary being welded together with an art that has never been excelled.

It will be evident from what I have written that the scene as viewed from one of the Seine bridges is of marvellous beauty and in-

THE TROCADERO GARDENS FROM THE EIFFEL TOWER.

French colonies to the left, foreign colonies to the right.

terest. Individual buildings may suffer from being somewhat crowded, but the general effect is thereby enhanced. On the one side of the river is Old Paris, with its quaint and picturesque structures; on the other is the Street of the Nations, every edifice in which, modern or mediæval, is of striking and characteristic design; all around and beyond are the magnificent Exposition palaces proper; in the distance is the curious congeries of minarets and domes that bespeak the presence of artificers from many remote corners of the earth. Such a *coup-d'ocil* could have been presented only on a comparatively restricted area; concentration of space was essential to its almost bewildering completeness.

Many visitors will also count it an advantage that the distances between all parts of the Exposition are not too great. Numerous detached areas have been incorporated, but riverside embankments, bridges, and avenues bring all into communication. Moreover, what

might at first sight be considered a drawback is skilfully turned to useful account, for the natural subdivision of the grounds is made to lend itself to a convenient grouping of the buildings. This rough classification not only saves sight-seers from fatigue by enabling them

THE BRIDGE OF ALEXANDRE III., CONSTRUCTED WHOLLY OF STEEL.

to view the entire display in sections and on different days, but it further results in a different keynote being struck, so to speak, in the various quarters of the Exposition.

Thus, on the Champs-Elysées Art is in the ascendant; we have here the highly ornamental if not altogether successful Monumental Entrance, the pavilions of Horticulture and Arboriculture, the city of Paris building, the Congress Hall, and the two great palaces filled with works of painting and sculpture. Crossing the Seine, by the Bridge Alexandre III., we reach the Esplanade-des-Invalides, where in two immense twin buildings, the one reserved to France, the other apportioned among all other nations, are displayed the million and one articles produced by a thousand and one manufactures; Industrial Enterprise is dominant here. Continuing our tour of the grounds and now descending the river, we pass along the Street of the Nations, a double row of sumptuous and diversified edifices where Embassies from every land dwell together, welcome visitors, and proclaim the

sentiment of "the Brotherhood of Man." But almost by way of ironical contrast we next enter the long mammoth structure devoted to deadly engines of war, military and naval; the spirit of Strife now pervades the atmosphere. Our itinerary then brings us to the Champ-de-Mars, where, around three sides of an elongated parallelogram, are ranged the palaces of Mines and Metallurgy, of Textile Fabrics, of Mechanical Engineering, of Agriculture and Food Products, of Electricity, of Chemical Industries, of Civil Engineering and Transportation, of Education and Instruction, and of Letters, Sciences, and Arts; in this quarter Inventive Genius is all supreme. The open end of the parallelogram, that next the Seine, is occupied by the Eiffel tower, round which are clustered minor displays of a more or less educative character, such as a huge globe showing the planetary system in motion, and a panorama giving the illusion of an actual voyage along the shores of the Mediterranean; Amusement is beginning to rub shoul-

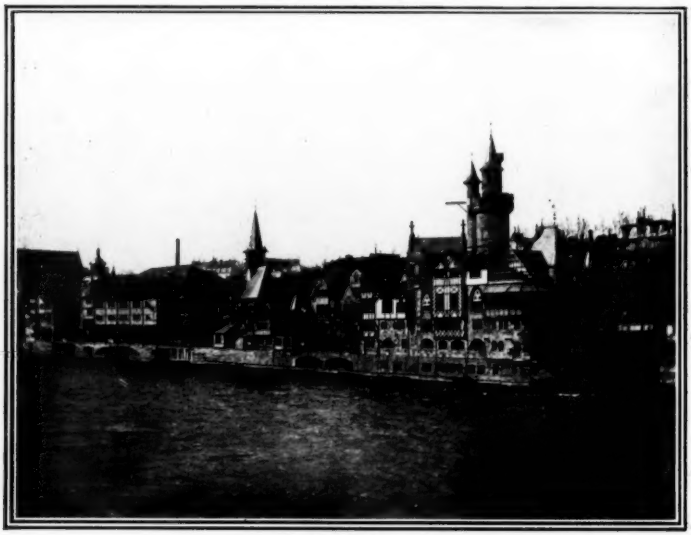
VIEW FROM THE BRIDGE OF ALEXANDRE III.

The lofty dome appearing near the Eiffel Tower belongs to the United States building. The Trocadero towers are in the mid-distance.

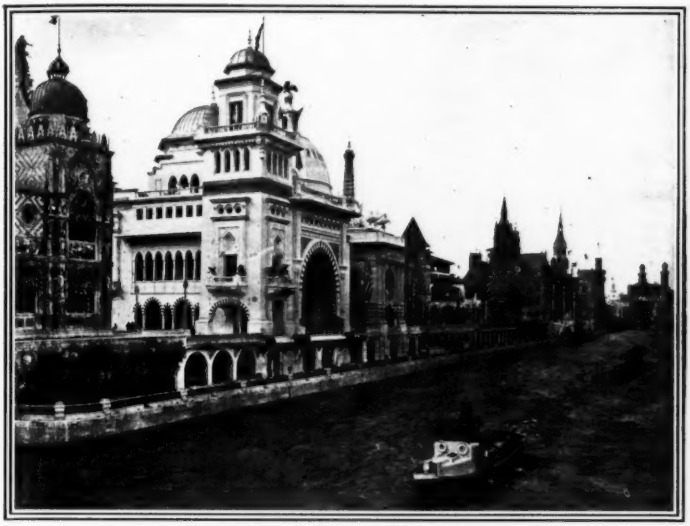
ders with Education. Re-crossing the river, we are in the Trocadero Gardens, where French and foreign colonial exhibits are gathered together in picturesque pavilions, mosques, kiosques, and entire villages, in which natives from a score of distant lands ply their trades,

and dispense music, theatrical performances, and characteristic dances; Gaiety begins to rustle in the breeze. Ascending the Seine towards our original gate of entry, we pass through Old Paris, where the costumes, industries, and diversions of former days are revived in streets and buildings that are archæologically correct in every detail; here we have Merriment, with just a lingering touch of Instruction. Finally comes the Street of Paris, composed of theatres, cafés chantants, dancing halls, and numerous other establishments of a type essentially modern and Parisian; in this neighbourhood Revelry is to be allowed to run riot during the period of the Fair.

The above brief description not only shows the convenient grouping of buildings, but will also serve to convey an idea of the comprehensive scope and the immensity of the Exposition. To complete the sketch, it has to be added that in a spacious annex at Vincennes, the East End park of Paris, connected with the Exposition grounds proper by a special line of railway, sports of all kinds, including cycling and automobilism, have their displays, and in each department elaborate international tournaments have been arranged for the summer months. Here also are to be found the exhibits in the important classes of railway and tramway rolling stock, and of agricultural machinery; while the United States has a special building in which is in-



OLD PAR'S



THE STREET OF THE NATIONS, LOOKING DOWN THE SEINE.

A portion of the Italian building shows first on the left; then comes the Turkish pavilion, partly concealing the United States building, the portico of which is surmounted by the Goddess of Liberty in the car of Progress, with Washington's equestrian statue beneath.

stalled a magnificent exhibition of machine tools crowded out of the allotted space in the Machinery Section.

To return to the main grounds, it may be said that electricity in all its varied applications has been made the dominant feature of the Exposition. In the vestibule of the principal entrance, a statue of Electricity confronts the visitor; at night time here the triple archways are a blaze of multi-colored lamps, while searchlights from the flanking columns send their beams over city, river, and Fair. The Eiffel Tower becomes a colossal monument illustrating the progress that has been made in a single decade, for it is tricked out from base to summit with as many incandescent lights as sufficed for the entire Exposition of 1889. The moving sidewalk, with a course of nearly three miles, forms a popular object lesson of electricity utilised as a motive power; in this instance, however, the French engineers have forgotten the peculiar charm of noiseless operation, for the track is an elevated one, with the result that the persistent roar overhead, comparable only to the rumble of ten thousand wagons, reverberates like muttered thunder through the adjacent palaces. In the Machinery

Hall, practically the whole of the power is distributed in the form of electric current. There are two great boiler houses, one at each end of the long building; the first has been installed by the French Government, the second by a syndicate of German firms. This latter circumstance helps to explain why on the day of opening the German machinery section was far-and-away the most advanced in the entire Exposition, for the practical, business-minded Germans had insisted on their space being handed over, roofed and floored, in ample time to permit of their part of the contract for supply of power to be fulfilled. Their gigantic travelling crane, operated by electricity, and busily engaged in completing the work of installation, soon became one of the great sights of the Exhibition. The total horse power provided is 20,000, capable of being doubled in case of need; of this amount, 15,000 horse power is devoted to electric lighting and 5,000 horse power to the operation of machinery. The two monumental chimneys that surmount the boiler houses well deserve mention; they are 80 mètres in height, have cost over 40,000 dollars apiece, and, both by their graceful design and by the use of encaustic bricks for decorative purposes, become veritable things of beauty, harmonising admirably with the general architectural features of the surrounding edifices. On the same level as the galleries of the Machinery Hall is the Electricity Building. Here, it goes without saying, the exhibition of electric appliances is one of magnificent completeness, not the least interesting pavilion being that in which the United States make a historical display of the newest practical science, with which their inventive genius has been so closely identified. The façade of the Palace of Electricity occupies the place of honour at the far end of the great rectangular space formed by the Champ-de-Mars; and it has been adapted to form what is termed the Chateau-d'Eau, which is unquestionably the great spectacular *"clou"* of the Exposition. A spacious and lofty hemispherical niche is crowned by an allegorical figure representing the Genius of Electricity, brandishing the torch of Progress, from which at night lightning flashes dart and dazzle. Beneath, the waters from condensing engines are turned to striking ornamental effect by being made to flow from a cascade a hundred feet high over a succession of richly sculptured basins. Myriads of electric lights and gorgeous fountain illuminations complete the scene, and render it one of unparalleled magnificence.

In an exhibition so vast, with many miles of galleries under roof and the grounds a crowded parterre of pavilions, it would be impossible within the limit of a single article to throw a comprehensive glance

over separate sections and individual displays. One example may be taken, however, to indicate the thoroughness with which the work of illustrating particular national industries has been performed. I shall select the Transvaal exhibit, partly because of its intrinsic merit and partly because of the world-wide interest that the South African Republic is attracting at the present time. At no International Exposition of the past has there been such an elaborate reproduction of all the processes connected with gold mining, gold milling, and gold saving. Regular underground workings extending to over 500 yards have been constructed, showing in most realistic fashion a mine level in full operation. The walls are built of ore brought from the Wit-

THE STREET OF THE NATIONS, LOOKING UP THE SEINE.

watersrand, the reef is visible with hanging wall and foot wall, the systems of timbering and electric lighting are represented; there are shafts, cages, drives, stopes, chutes, tramways, etc.—everything complete. Above ground is a milling plant, with driving engines, ore elevators, rock crushers, a battery of five head of 850-pound stamps, amalgamating plates, and vanners, performing their different functions. Next comes a cyanide equipment, with tailings wheel, collecting tank, leaching vat, and pumping gear. Finally, we have the laboratory, where the delicate processes of precipitation, smelting, retorting, refining, and assaying are being carried on by expert metallurgists. The visitor thus follows the ore from the reef to the ingot. The complete-

ness, compactness, and intense practicality of this installation reflect the enterprise of the cosmopolitan city of Johannesburg.

As with all such Expositions, the Paris World's Fair will vanish in a few months' time. But no previous undertakings of the kind have left such a permanent impress on the cities that have given them brief but splendid existence. The massive Pont Alexandre III., constructed entirely of steel, will afford a much needed additional artery for traffic and a magnificent new approach to the Hotel-des-Invalides. The Art Palaces on the Champs-Elysées have been erected for all time, and will

VISTA FROM THE ART PALACES ON THE CHAMPS-ELYSÉES TO THE DOME OF THE INVALIDES.

The Great Palace of Art is on the right foreground, the Little Palace on the left. The bridge of Alexander III., with its four ornamental columns, leads to the Palace of Manufactures.

leave Paris with the finest picture galleries and museum building in the world. Two new lines of railway have penetrated to the Champ-de-Mars, one of them in its building having performed the important service of demolishing the worst thieves' dens and cabarets in the notorious Quartier Maubert. Then, the underground railway, which forms a perfect network of intercommunication, will be a precious legacy, relieving the boulevards and streets at present almost hopelessly encumbered with vehicles of every description. So, when the final débris of the Exposition comes to be swept away, Paris will find herself a much beautified and much improved city.

DISAPPEARING GUN CARRIAGES IN THE UNITED STATES.

By G. H. Powell.

CURIOUSLY enough, though the disappearing type of carriage for seacoast guns had its origin in Europe, it is in the United States that it has reached its greatest development, while its use has practically been abandoned by the European governments. In fact, it has recently been stated in the public press, on the authority of a prominent English ordnance expert, that the consensus of opinion among artillery experts throughout Europe is utterly opposed to the use of disappearing carriages of any kind.

However this may be, the disappearing type of carriage plays a most important part in the mounting of the large guns of the United States coast fortifications, over ninety per cent. of the 8-, 10- and 12-inch calibers being on this style of carriage; so that for the present, at least, the country may be said to be committed to this type. And since this is the case, it may not be uninteresting to trace briefly the progress of invention which has led to the development of the disappearing carriage as used in the United States to-day.

The system of disappearing carriages appears to have originated with Colonel Moncrieff, of England, who patented his invention in that country in 1864, though the details were worked out by Sir W. G. Armstrong & Company. Colonel Moncrieff proposed that the enormous energy of recoil, or "kick" of the guns in firing—a pressure amounting to upwards of 35,000 pounds to the square inch—should be utilized in bringing the gun down into a protected position behind an earthwork, and at the same time be used in storing up sufficient energy to raise the gun into firing position after it had been loaded.

The "Moncrieff" mountings were so designed that a heavy counterpoise tended to keep the gun up in firing position. The energy of recoil was absorbed in lifting the counterpoise, and a ratchet and pawl kept the gun in the position to which it finally recoiled. In operation, each time it was fired the gun recoiled to the loading position, in which

General Miles, the highest officer of the United States Army, under the President, has very recently expressed a sharp criticism of the policy of giving the disappearing carriage an overwhelming predominance in mounting the guns of the new United States coast defences. For this reason, and even more from the fact that the disappearing mounting represents an invasion ot purely military science by advanced mechanical engineering, Mr. Powell's paper is especially pertinent.—THE EDITORS.

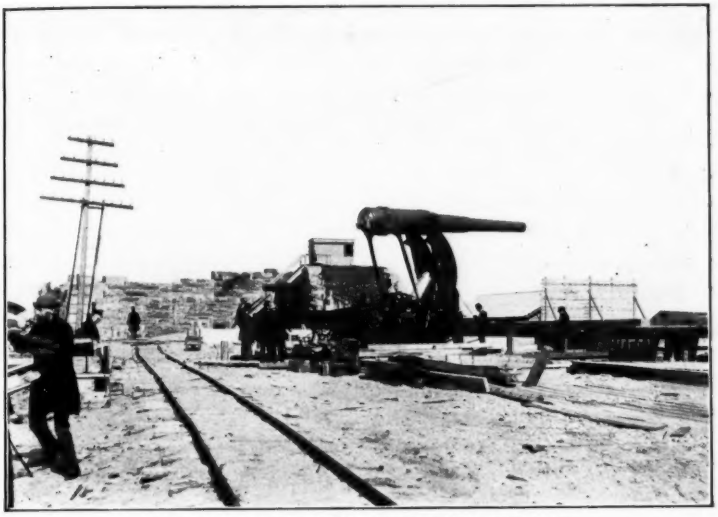
it was held until loaded, then, on releasing the pawl, the counterweight lifted the gun into the firing position, or, as it is termed, "in battery."

Some advantages of the disappearing-carriage system, belonging generally to the various forms which have been from time to time proposed—all of which, in a general way, conform to the foregoing description—may be briefly summarized:

The gun is loaded, traversed, elevated, and worked generally in a pit or behind an embankment. While in the "down" position, in which the recoil places the gun, it is almost absolutely safe from any fire that can be directed against it by ships, and this protection is obtained without other means than earth and concrete, thus avoiding the use of heavy and expensive armor plates; to the advantage of unlimited protection afforded by the earth must be added the important feature of concealment, as it must be borne in mind that the glacis of the fortification—the only part visible to an enemy—can scarcely be distinguished from the surrounding country. There is, therefore, nothing to draw attention to the presence of a powerful gun which may be loaded and ready to appear for a brief moment to deliver its fire and then disappear from view.

A test of this system was made in England in 1885 by practice

UNITED STATES PNEUMATIC DISAPPEARING CARRIAGE.
The gun in the loading position.



UNITED STATES PNEUMATIC DISAPPEARING CARRIAGE.
Showing the gun fully elevated.

from H. M. S. "Hercules." A pit was dug and a model gun was arranged to rise up every two minutes, remain exposed for twenty seconds, and then sink down again; a puff of powder, fired just before the gun disappeared, made the conditions for the ship's practice exactly similar to those which would have been experienced had the gun been a real one.

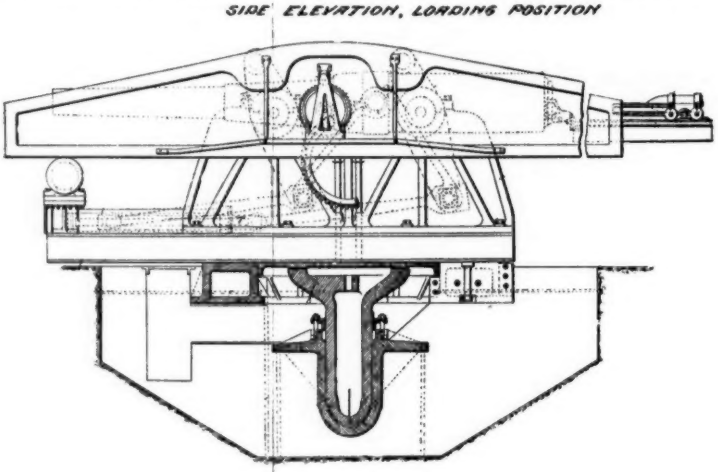
The trial commenced by an attack of machine guns; hundreds of rounds were fired, but not a single bullet fell inside the pit. Broadside firing with heavy guns was next tried, and although the practice was good and some fragments of shell struck very near, the model escaped unhurt. Lastly, independent firing from the heavy guns was carried out, but the practice was bad and consequently the model was in no danger.* The trial was a thoroughly practical one and proved beyond doubt that a gun on the disappearing system is better protected than in any other manner.

When a ship engages a fort or turret she at least has the satisfaction of having something to aim at; but with a disappearing gun even this is denied to her, for with smokeless powder, such as is now used, and the gun in sight but a few moments at best, the vessel must take hard blows without being able to return them.

* See "Artillery, Its Progress and Present Position," by Lloyd and Hadcock.

Without stopping to trace the progress of the development of disappearing carriages in Europe, where their use in service has practically been abandoned, we will consider only the types to be found in the United States, where the system may be seen at its best.

The first form of disappearing carriage used in the United States was made after plans of Captain King of the corps of engineers. In this type the side plates of the main carriage, or, technically, the chassis, are inclined to the rear, and the gun and top carriage recoil down this incline and at the same time lift a counterweight, which is attached to the front of the top carriage by means of ropes passing over a fixed pulley placed between the front ends of the chassis rails.



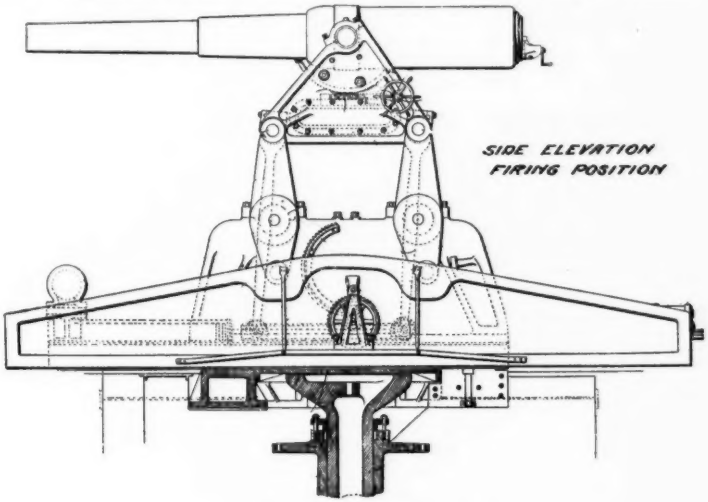
Gordon 10in Carriage.

This form of carriage never came into general use, as it was not well adapted to the strains incident to the recoil of high-power guns.

The Pneumatic Gun Carriage and Power Company have constructed a carriage for a 10-inch gun in which all the motions of the gun are controlled by pneumatic power; that is to say, the recoil is taken up and the gun returned to the firing position by this means, and pneumatic power is likewise used in loading, elevating, and traversing the gun. A small reversible air engine is geared to the elevating and traversing devices. The loading device consists of a pneumatic lift for raising the charge to the breech of the gun and a pneumatic rammer for forcing it home. While this carriage may be said to

work satisfactorily, it requires a steam plant for its service in compressing the air, which is used under a pressure of 1,000 pounds to the square inch, and, like the King carriage, it has never come into general use, though a second carriage designed by the same company is now nearly completed and will soon be tested.

Another form of disappearing carriage was that designed by Capt. W. B. Gordon of the United States ordnance department. It is a counterpoise carriage, the motion of recoil being transmitted through a series of lever arms to the counterpoise, which is of cast iron and placed on either side of the gun. This carriage has the advantage of an all-round fire, which is not ordinarily the case where a counter-



Gordon 10in Carriage.

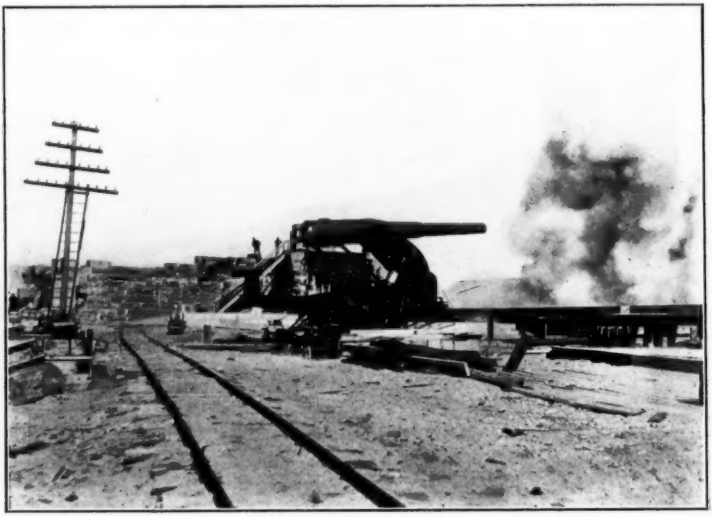
weight is sunk in a well beneath the gun. An examination of the photographs will more clearly indicate the design. Like its predecessors, it has never come into general use.

There yet remains the Howell carriage, the invention of Admiral Howell of the United States navy, but as this carriage is still undergoing the official tests description of it will not be given.

Some years after the abandonment of the King carriage, a design was proposed by the present chief of ordnance of the United States army, Gen. A. R. Buffington, then captain in the ordnance department, and this was later materially modified by Capt. William Crozier

of the same corps; but though the Crozier-Buffington disappearing carriage of to-day is based on the original designs of these two officers, it has undergone many modifications and alterations as the result of its actual use in the hands of the troops. The outline sketch will show the general form of the carriage.

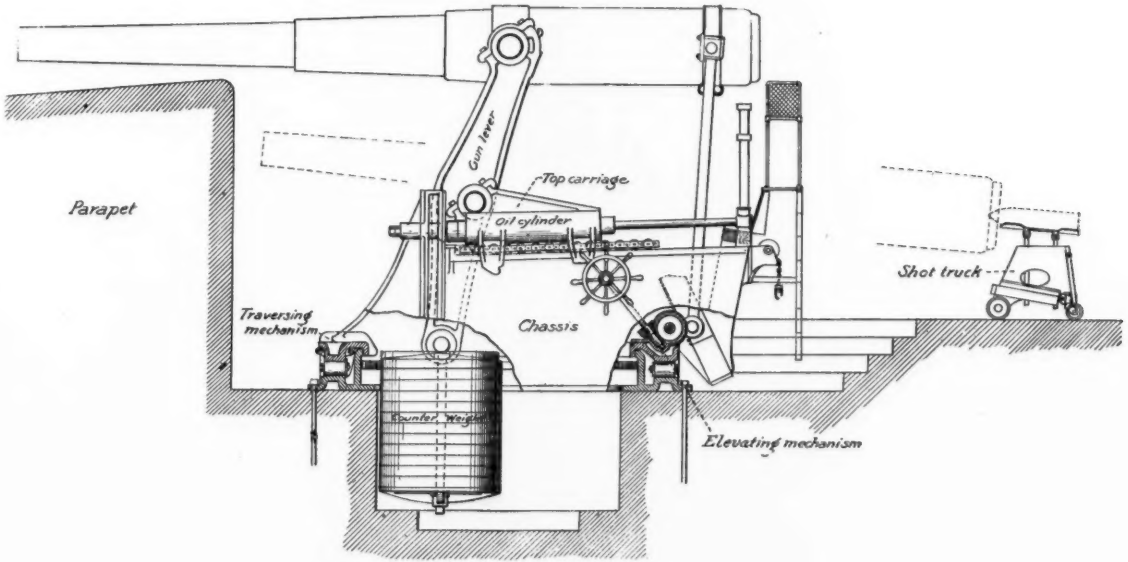
Two parallel levers are mounted on a horizontal axis which is trunnioned or journaled in a movable top carriage. The gun is



UNITED STATES DISAPPEARING-CARRIAGE GUN UNDER TEST AT SANDY HOOK.
The first discharge.

mounted on the upper ends of the levers, and a counterweight is attached to the lower ends. The top carriage carries two oil cylinders and the ends of the piston rods sliding therein are attached to upright brackets at the rear of the main frame or chassis. These oil cylinders are peculiar, in that constant resistance is obtained by the passage of the liquid from front to rear through orifices in the piston head which become smaller as the top carriage moves backward. The cylinders are thus employed to reduce the shock on the stationary parts of the carriage, and they also play an important part in taking up the recoil. In their original form, these cylinders were the main modification by Capt. Crozier of the first designs of this carriage.

During the recoil the top carriage slides to the rear on the slightly inclined chassis rails and the counterweight rises, while the trunnions



UNITED STATES DISAPPEARING CARRIAGE
Model of 1896.

of the gun describe ellipses in passing to the loading position. The gun is sufficiently over-counterpoised to enable it to return easily to the firing position after being loaded.

The gun is elevated and depressed by means of two arms which are attached at their upper ends to a band near the breech end of the gun, the lower ends being fastened to massive blocks which slide between guides, and the movement of these arms in a vertical direction serves to depress or elevate the muzzle of the piece, as the target may be near or far (see p. 417). The gun is loaded from a truck, which may be seen on the platform at the rear. Guns as usually mounted on this carriage have a field of fire of 120° and a vertical motion from 5° depression to 12° elevation, though a late modification of the design has been made for a 10-inch gun which allows an all-around fire—a condition, however, which is seldom called for in the actual defense of a position.

All the operations of this carriage may be made by hand, but a series of tests are now in progress, with excellent prospects of success, for the application of electric power to the manipulation of the carriage and the service of ammunition, thus saving a material expenditure of "man-power." The supplying of the necessary electric current is a comparatively simple proposition, since all modern fortifications have a complete electric plant for lighting the magazines, operating searchlights, and so on.

The advantage of a mechanical operation of these guns may be better appreciated when the great weights to be moved are considered. A 10-inch gun, for instance, weighs about 67,000 pounds, and the carriage about double as much more, while a single solid-steel shot of the same caliber weighs 575 pounds and requires 250 pounds of powder. A 12-inch gun and carriage is more than double the weight of the 10-inch, and a 12-inch solid shot weighs 1,000 pounds, with a powder charge of 500 pounds. A 12-inch gun detachment consists of 27 men.

These carriages, as installed in the coast fortifications of the United States, have reached a very high degree of perfection in mechanical detail. Whether or not they are best suited to meet the rigorous test of actual warfare is yet to be determined.

EDITORIAL COMMENT

The House of Representatives of the United States Congress, by a vote of nearly seven to one, has declared for the construction of the Nicaragua Canal. An amendment designed to make the bill cover an isthmian canal, leaving the route subject to determination after the investigating commission could hand in its report, was emphatically rejected.

Fortunately, the Senate stands between the United States and a $140,000,000 leap in the dark, and before a basis for concurrent action by both houses is found, the country may be in possession of facts which will determine whether the Nicaragua Canal can be built even for $140,000 000. The jingoes seem to have bristled up against an imaginary foreign opposition to the construction of the waterway, and to have placed the recently passed bill as the proverbial "chip on their shoulder." The forces against which any canal on the Nicaraguan route seems likely most to need "protection," so far as our present knowledge goes, are threefold:

(1) A general drift of the sands along the Gulf coast, which has filled up Greytown harbour in a very few years, and against which no adequate protection seems yet to have been suggested.

(2) The menace of earthquake disturbance sufficient to imperil not only the stability, but the very existence, of a construction so dependent on dams, embankments, locks, and cuttings.

(3) An apparent wide fluctuation in the level of the lake which is to furnish the water supply for the entire canal.

Possibly the President and his advisers may be relieved of serious embarrassment if these factors can be eliminated from the problem before they are called upon broadly "to protect" the canal.

These are fundamental points, and beyond them lie all the serious questions of engineering construction for which no answer is found in any report or study yet presented. An Act of Congress will not establish the canal. Even "patriotism," as it is conceived by the canal advocates, will not replace sound engineering nor common sense and good judgment. Building a canal without knowledge may prove more expensive than building a tower without counting the cost.

* * *

A good deal of comment has been excited by German preparedness at the Paris Exposition, as it appears in contrast with the semi-chaotic condition of most of the space at the opening. Mr. Mitchell, elsewhere in this issue, refers to this as it is displayed in the machinery section; other observers have reported it more generally. One writer is particularly impressed with the imposing character of the German navigation exhibit, with its "ominous" legend, "*Unsere Zukunft Liegt auf dem Meer*" ("Our Future is on the Sea").

The industrial and mechanical advance of Germany—of which ship-building progress is the most comprehensive expression—is certainly significant, if not "ominous," for the United States and England. Looking back to the marvellous record of the last quarter century, the English-speaking engineering world may well ask seriously as to the future. One thing seems certain—remarkable changes in the distribution of industry, which Mr. John Richards discussed ably in our April issue, are now pending. The total is, of course, vastly greater from year to year, but the foci are shifting. Hardly anyone would have believed, in 1870, that German ship-builders would turn out a Kaiser Wilhelm der Grosse before the end of the century; but now, according to recent reports, the same yards in which she was built are preparing to lay down a ves-

sel far exceeding the Oceanic in size and the Kaiser Wilhelm der Grosse in speed American machine-tool makers are beginning to feel the effects of the great German tool-building establishments. How far is German thoroughness in study and organisation destined to offset her later start and her apparently permanent disadvantages in the matter of iron and steel supply?

* * *

A very intelligent English commentator on American and British characteristics in mechanical manufacture, as they appeared to him after an extended tour throughout the United States, sums up the advantages of the American manufacturer as lying under three headings: "An unlimited supply of cheaper raw material and fuel, and cheaper transport; in many cases better arranged and equipped workshops and more up-to-date tools; and, finally, a higher rate of output from their workmen."

The first point Mr. Jefferies considers "the most serious one for English manufacturers," and most students of the matter will confirm his judgment. He points out, however, that owing to certain conditions, iron and steel are selling at higher prices in the United States than in Great Britain. He does not mention, as a cause contributing to this end, the tariff, which, whatever it may have done to foster "infant industries," is surely no longer needed by the giant iron and steel makers of America, and is becoming a serious handicap to the makers of American manufactures of every kind in their newly awakened essays in the world's markets At present the American manufacturer to whom iron and steel are raw materials is actually at a disadvantage as compared with his European competitor, in spite of the superior richness of his country in iron and fuel deposits. And, furthermore, the furnaces and mills of the United States will sell to all the world—to foreign builders of electrical machinery, engines, or machine tools as cheaply as to home manufacturers—and in the export markets freights will nearly or quite equalise themselves by time the finished goods from the respective sources are at their destination.

As to the second point—equipment—English works are certainly "catching up" at a wonderful rate; and as to the third—higher rate of output from the individual workman—Mr. O'Connell's article in this issue will show how strenuously the American machinist is seeking to commit industrial suicide—or, at least, mayhem upon himself.

* * *

In view of the growing appreciation of the value of standardisation, in connection with every department of engineering work, it is greatly to be hoped that the efforts of the Secretary of the United States Treasury to establish a National Standardising Bureau will be attended with success. The foundations of knowledge are said to lie in definitions, and the foundations of profitable and mutually helpful international trade certainly lie in agreement upon the definitions of those standard measures, weights, units, and physical constants which are the basis of specifications and contract agreements. And it is certainly to be expected that such a bureau, if established, would work in harmony with the similar departments already founded and in operation in England, Germany, Austria, and Russia, with all of which countries the United States have a constantly growing commerce, which will be the direct gainer by the work of the bureau.

The contemplated expenditure is very moderate, being $300,000 for site, building, and equipment, $10,000 for general (presumably annual) expenses, and $34,000 for annual salaries. The amounts annually appropriated for similar purposes by several European Governments are as follows: England, $62,100; Germany, $116 000; Austria, $46,000; Russia, $17,500.

The movement is certainly in line with enlightened effort for international agreement in matters of international engineering interest, and it is to be hoped it will be favourably reported by the Committee on Appropriations and will receive the approval of Congress.

REVIEW OF THE BRITISH PRESS

Workshop Administration.

IT is a significant fact in connection with the general transformation which is taking place in works management, that a broader view is beginning to be held regarding the scope and character of shop accounts and workshop administration. This is clearly seen in the paper of Mr. David Cowan, recently presented before the Institution of Engineers and Shipbuilders in Scotland, upon the subject of workshop administration with special reference to tracking work and promptly ascertaining detailed costs and profits.

Mr. Cowan strikes the keynote of the whole matter when he says that the selling price of the product is determined, not so much by its cost as by competition.

"The prevailing idea regarding shop records is that they are only necessary for determining the selling price of the product. The accountant and his needs for arriving at the final results are considered all important, and it is held that any clerical labour over and above is needless. The important functions of records in pointing out where economies may be effected, production quickened, and supplies regulated, are usually lost sight of; and the practical officials are depended upon for the performance of those functions which ought not properly to devolve upon them in detail."

In other words, the shop records should form an efficient guide in showing how and where to meet competition. It is not enough to ascertain how much a product costs, it ought to be shown in what manner this cost is subdivided, how it has been incurred and how its details compare with former identical products. In this way only can intelligent action be taken to reduce costs, and consequently to meet competition.

Mr. Cowan proceeds to describe in detail a general method of cost-keeping based upon the shop-order system, showing the manner in which the orders are originated and transmitted through the works, prior to their ultimate classification and record, and emphasises the advantages of the card system over that of bound books for this purpose. A general chart of the system is given, as well as examples of the individual forms, and the whole is discussed at greater length than can here be given. Such a system necessarily requires modification to adapt it to the peculiar requirements of each establishment, and hence it is the principle, rather than the concrete example, which is most important.

The really interesting portion of Mr. Cowan's paper lies in the manner in which it reveals the necessity for the advocacy of what might have been supposed to be an obvious necessity long ago. Apparently it is only when the pressure of competition has brought the matter home to the works managers of Great Britain that they have thought it necessary to give it serious attention.

"In many of the older shops little attention has been given to matters outside the accommodation which may be described as purely productive. General office accommodations, store rooms, work office, etc., have been looked upon more or less as luxuries and sources of unnecessary expense. Proprietors have ever before them the weekly outlay in wages paid to all kinds of indirect producers, but it is only with difficulty that they can realise the losses arising from waste and leakage. They are particularly careful in the handling of actual cash. They do not object to a bookkeeper spending days or weeks looking for an error of a few pence in his balance, but they are not equally alive to the necessity for supervising other items which just as really represent cash. We are now wakening up to the necessity of eliminating waste in every form."

It is not enough to wake up to the necessity for keeping a detailed account of costs; it is also necessary to maintain an accurate record of other details of shop administration.

As Mr. Cowan rightly says, this is a matter which cannot originate with a manager on his own responsibility; it must emanate from the principal, who must thoroughly realise its importance. Even then it will be found a difficult task to introduce modern methods of shop accounting into an old-established shop.

"The old hands who have honestly and conscientiously toiled to build up a business in its early stages under a 'leading-hand' and 'head-of-department' system, which permits of the operation of independent control subject to little or no itemised criticism, are at the outset likely to resent the recording and examination of their individual acts. The march of events will, however, force compliance with the inevitable, and so will arise the necessity for bringing forward a class of men trained in the general principles of administration, and in the scientific and technical principles of design and construction."

A knowledge of the facts, however, will not save the old-established works from the disastrous effects of successful competition, and the best system of accounting is but a means to an end. Behind it must be the intelligence to perceive the meaning of the collected and classified information, and with this must be the capacity to plan improved methods, and determined energy to carry them out. The manufacturer who expects a new system of cost-keeping to reorganise his business and bring profits out of losses will be sadly disappointed if he leans on what will prove to be a broken reed. It is he himself who must have the courage and determination to install and execute the reforms which the best system can only reveal and indicate, and it is to this that the proprietor and manager must awaken.

American Competition.

NOTWITHSTANDING the quantity of matter which has been written upon the subject of the competition of the United States with the industries of Great Britain there appears to be room for further discussion of the matter. A recent editorial in the *Engineer,* in discussing a series of articles in the *Times,* brings out some points which are worthy of comment, as bearing upon the main question.

There is no doubt as to the magnitude and importance of American enterprise. The resources of the country and the energy of the people are admitted facts; the question is as to the influence of British industries. Here we meet at once the fact that we must consider not alone the producing powers of one nation, but the buying powers of several.

"It is a fundamental principle of political economy that no one country can prosper as the result of manufacturing effort unless some other country prospers also, because prosperity depends on volume of trade, and trade consists in the interchange of commodities." When, however, three or more countries are concerned, one must be left out in the cold. It is the American invasion of England's foreign markets which is to be considered.

"At the present time the United States is probably the only self-supporting domain on the face of the earth, but the demands for home supply are such as to render it probable that for many years to come the people of the great transatlantic nation will consume so much of their own products that comparatively little will be left for export.

"When, however, the home demand falls off, there must be a sharp and powerful competition with England in her foreign markets, for which she would do well to prepare.

"If, for example in detail, 60 per cent. ore can be dug out of the side of a hill by steam shovels, lifting 5 tons at a time, and put into 25-ton wagons at a cost of 8d. per ton, what chance has the English or Scotch or Welsh ironmaster, who has to import his ore from Spain and pay from 14s. to 20s. a ton for it?"

It is against such competition that the manufacturers of England must prepare themselves to fight. "Ostensibly American competition ought to have brought financial ruin on this country long since. The fact that we are enjoying unprecedented prosperity seems to indicate that after all there are conditions at work which save us, and which are neither fully understood nor appreciated at their proper value. The operation of these factors has been strangely overlooked. England never is, but always is to be, ruined by foreign competition. The

pessimist tells us that present prosperity is all very well, 'but wait for a year or so.' We have heard all this said with impressive if monotonous regularity for over thirty years, and still the sword has not fallen."

Nevertheless it is important to study the methods of American competitors and, apart from the advantages of cheap raw materials, ascertain the sources of their operative successes. The advantage of repetitive methods, of automatic machinery, of the specialisation of industries, all these have to be considered. Then, too, the importance of correct systems of works organisation, of accurate cost-keeping and distribution of expense, indicating where economies may be effected and costs reduced, must be appreciated. The study of modern methods in all lines of work, the result of advanced technical education, is an element for consideration, this especially being one of the sources of Germany's strength in competition.

Now, while the possible future effects of American and other competition are realised, and while prosperity at home renders preparation possible and practicable, every effort should be made to meet the impending situation.

"If the people of this country take the proper precautions they will not suffer; what these are has been stated over and over again. There is nothing new to be said on the subject. There is danger in American competition, but no imminent or enormous danger. Great Britain has far more to fear just now from her own people than she has from those of the United States."

Submarine Boats.

A RECENT editorial in *Engineering* discusses the merits and failings of submarine boats in a very interesting manner, and since this important question is treated from an American standpoint elsewhere in this issue, the British view point is a fitting subject for review.

In France it is reported that a fleet of 100 submarine boats has been ordered by the government, while in the United States the Holland boat has been purchased by the government, after exhaustive and critical trials.

The article in *Engineering* is mainly devoted to an indication of the peculiar difficulties involved in submarine boat construction and operation, and these are doubtless many and great. Reviewing the experimental work in this line since the partially successful experiments of Fulton in 1801, the defects in all the subsequent devices are shown, and the drawbacks which must attend the use of even the partially successful boats of the present time.

"The flooded boats, which keep awash, just under the water surface, look like torpedo boats. They are spacious enough not to need any compressed air stores for breathing; and the tube projecting above the water level, provided with a mirror at an angle of 45 deg., is a help to the man at the helm—not much of a help, though, for the elevation is too small to give a proper field of view. In stability these craft are superior to the totally submerged boats, but they suffer from many of the drawbacks of submarine boats which are regarded as serious, notably by such an expert as Professor Busley. He is acting President of the newly-formed Schiffbautechnische Gesellschaft, a German naval constructors' institution, whose inauguration recently was attended with so much *éclat*, due to the presence of the German Emperor to hear the Professor's contribution on this important subject of submarine boats.

"Amongst those serious inherent difficulties, Professor Busley places first the low stability of submarine boats. Some people still seem to forget that the displacement centre of gravity of a totally submerged boat is simply the mass centre of the water displaced, and does not alter its position, whatever inclination the boat may assume. There is no buoyancy. Yet transverse stability and prevention of rolling is not so difficult to obtain, provided the section of the boat is like that of an egg, poised on its point. If we use ballast, the centre of gravity of the system will be low down, and the displacement centre high up. The low longitudinal stability, the tendency to pitching, is the trouble. A man need only step forward to send the nose of the boat down. For this reason the Plongeur of Bourgois failed, and the length of boats has been reduced again. Goubet has gone furthest in this direction, and his two men always sit in the middle of the boat. Bauer tried to apply counterpoises, Holland automatic

pumps, to restore longitudinal equilibrium. Nordenfelt did not deprive his boat of all buoyancy, and counteracted its effect by a submerging propeller. The flooded boats are better off in this respect. But even in their case we notice a reduction in length; the Zédé had a length of 45 metres, the Morse of 36 metres, the Narval of 34 metres. It has, on the other hand, been pointed out that they are not good sea-going boats, hardly fit for rough weather; and their own designers have proposed to give them a little freeboard. If we do that, we lose the chief advantage of the submarine boat, the immunity against projectiles; and we may argue whether we had not better return to ordinary boats, in which we are not tied down to small space and small speed, and all sorts of undesirable conditions.

"Submarine boats remain dangerous to manage. On the average, perhaps, we may construct them strong enough to descend to a depth of 100 ft. Supposing a boat, moving at the usual speed under water, 8 knots, is to discharge a torpedo. Two men are sent forward; the boat at once inclines 15 deg., and within half a minute it will have arrived in its critical depth. If there is any delay or any fault in the steering gear or in the application of safety weights, etc., every second will seriously increase the pressure of the water outside. Trials made with the Gymnote, moreover, indicate that submarine boats do not obey their horizontal helms with sufficient rapidity. The Gymnote always overshot her mark, and would not keep on a straight course, but described a succession of curves. Professor Busley tried to pull a submarine boat under water; it could not be done when the speed exceeded 4 knots. That all operations near the coast or in shallow water are exceedingly dangerous, need not be emphasised."

While all these difficulties doubtless exist, they are not unsurmountable, and the trials of the Holland boat show that to a certain extent, at least, they have been overcome. It will not do to sit still and argue about the difficulties of making and operating submarine boats, while other nations against which Great Britain may suddenly be called to contend are patiently working to solve the problem. The greatest battleship afloat may succumb without a blow to the insidious stroke of the submarine enemy, while any harbour protected by such invisible defenders may consider itself practically safe. If these possibilities are involved in the possession of successful submarine boats England should bestir herself to learn by practical construction and test just how far such possibilities may become stern realities.

The Development of Germany.

ALTHOUGH the continual advance of Germany in the commercial, economic, and technical worlds has been known in many quarters it has remained for the valuable report of Mr. Gastrell, the commercial attaché to the Embassy at Berlin, to place the facts before the English-speaking public in a condensed and comprehensive manner. The position of Germany, as a powerful and united territorial nation, was initiated in 1871, since when its strength has rapidly grown year by year in every direction.

"The German Empire, as a Continental great Power, has now far surpassed the expectations of its founders thirty years ago. Who can say how far the next three decades may not fulfil the present national aspirations of becoming a future "world power"; by which is meant the acquisition of the status of a great naval and colonial Power in the whole world in addition to the position of the leading territorial great Power, already obtained in Europe? 'Imperial unity,' was the cry of 1871. 'Imperial expansion' is the watchword of 1900.

"In industrial and commercial matters, the first 20 years of the existence of the German empire, from 1871 to 1890, were devoted to the elementary education of its people; the following 10 years, 1891 to 1900, have been spent on their higher education, and the twentieth century sees in them a body of men, each an expert in his own trade or profession."

Since the prosperity of Germany depends primarily upon its trade, and secondly upon its agricultural resources, it follows that the growth of German power can best be gauged by an examination of the state of the national industries, followed by a view of the condition of the landed interests. Mr. Gatchell gives very complete statistical data concerning the development of German industries, from which some valuable general conclusions may be drawn.

The population of the German empire is now about 56,000,000, having increased by 15,000,000 since 1871, but while emigration has very greatly diminished the demand for labour can hardly be supplied. In view of the possibilities of future economic expansion, it is well to note that in the three leading industrial countries of Europe the yearly increase of the population accruing from the excess of births over deaths is, approximately 850,000 in Germany, 450,000 in the United Kingdom, and only 35,000 in France.

The data for comparisons of commerce in various years are given in detail, for which the original report must be examined; it is sufficient to note that in 1872 the imports amounted to £163,000,000, and the exports to £116,000,000, while for 1899 the imports reached a value of £259,850,500, and the exports £166,000,000. In this connection it is important to note that the quantity and value of the imported raw materials for local manufacture are yearly increasing, and that, at the same time, the quantity and value of exported manufactured articles is also steadily rising from year to year.

The extraordinary growth of German maritime interests also bears witness to the development of national prosperity. A recent official calculation states that at least 70 per cent. of all German commerce is now carried by sea. In actual tonnage German shipping now stands second in the world, with 1,594,596 tons, and its steam tonnage in 1899 was about 10 times as great as that of 1872. During the last 25 years the relative proportion of the mercantile marine of Germany to that of the whole world has risen from about 5 to more than 8 per cent.

The development of the various states constituting the German empire is given in detail in the report, and a view of the progress in Prussia may be taken as typical of the others.

The total revenue of Prussia was £33,250,000 in 1872, and is estimated at £119,987,185 for 1900, an increase of about 210 per cent. It is true that the public debt has increased from £64,363,000 in 1872 to £329,584,000 in 1900, but it should be remembered that this large debt was almost entirely contracted for the purchase of the State railways, which form by far the most important of the paying properties of the Prussian State. This should therefore be looked upon as an investment, and not as an unremunerative debt in the ordinary sense.

One of the most important branches of State expenditure, so far as technical progress is concerned, is that which has been made for education, and especially technical education. In 1871 only £15,000 was spent on industrial schools, while the estimates for 1900 allow a sum of £281,000 for this object. "It will thus be seen that the Prussian government has devoted great care to the important question of education, especially in the matter of technical and commercial education. As regards the latter, for instance, the receipts in 1890 were £2,500, and the expenditure £93,000, as compared with £30,000 and £195,000 respectively, in 1897. And, during the same interval the total number of State schools of engineering and architecture rose from 1 to 13, and that of schools for machinery and mining, etc., from 1 to 7."

These are a few of the bare facts, but the real purport of the development of Germany is seen by everyone in the manner in which she has invaded the markets of Britain everywhere. "Made in Germany" is no longer a warning or a reproach. *"Billig und schlecht"* has been replaced by *"Billig und gut,"* and the German flag is seen in every port. This advance is the result of no sudden spurt, it is the consequence of the steady development of nearly a generation, a development, the foundations of which were laid by Prince Bismarck, and the superstructure reared by his successors.

How England can best meet this competition remains to be seen. Certainly not by ignoring it, nor yet by evidence of distrust in her own capacity. Anglo-Saxon determination, backed by the resources and prestige of generations of commercial and technical supremacy, must be fully equal to the task, but the magnitude of the task must be appreciated in order that it may be successfully accomplished.

The Electrical Equipment of War Ships.

THE use of electricity for the transmission of power to the various parts of a vessel has been an attractive problem for several years past, especially since the general introduction of electric lighting has

rendered the installation of some kind of a generating plant a necessity.

This whole matter of the electrical equipment of war ships forms the subject of an exhaustive paper recently presented before the Institution of Electrical Engineers by Mr. C. E. Grove, from which some extracts are here reviewed.

The author especially disclaims the intention of discussing administrative and tactical questions, treating the subject solely from the point of view of the independent electrical engineer.

Naturally much of the work which has already been done has been in British war ships and in ships built in England for foreign governments, and Mr. Grove devotes the first part of his paper to a description of some of the existing installations on British vessels.

One of the earliest applications of electricity on shipboard was that of lighting, and in his paper Mr. Grove discusses the growth of electric lighting for naval use, including incandescent lights for general purposes, signal lights for use at sea and at anchor, and search lights for special service, and compares the practice of various countries in connection with this important branch of the service.

The principal differences between lighting on shipboard and on land lie in the methods of running the cables and providing accessibility to all parts, while at the same time avoiding the weakening of watertight bulkheads. Various methods have been employed, including the use of iron or wooden conduits, but the British Admiralty system of lead covered cables, closely packed together, and visible and accessible throughout their whole length, is greatly to be preferred to any method in which the wires are concealed.

It is, however, for power transmission, replacing steam or hydraulic auxiliaries, that electricity is at present chiefly attracting attention. This phase of the subject is discussed at length by Mr. Grove, and the gradual displacement of steam by electricity is a matter of comment. Until a few years ago the whole of the auxiliaries were steam-driven, with the exception of the gun-working machines, for which hydraulic power was preferred. By degrees electric driving has been applied to one and another, the most advanced example being the U. S. battle ship "Kearsarge," just completed, which carries 55 motors and a generating plant of 350-kilowatt capacity. Much of the discussion relating to the advisability of replacing steam auxiliaries by electric driving is due to a realisation of the wastefulness of the small steam engines used for the various auxiliary machines, and at the present time it is still an open question whether or not the steam auxiliaries can be so improved in economy as to maintain their supremacy.

Mr. Grove examines the important paper of Passed Asst. Engr. W. W. White, U. S. N., upon the tests of the auxiliaries of the American cruiser Minneapolis, and also the recent papers of Lieut. J. K. Robison, U. S. N., in THE ENGINEERING MAGAZINE for October and November, 1899.

Mr. Grove takes issue with Lieut. Robison in his contention that the excessive weight of motors for electric driving would be objectionable, and maintains that with properly designed and selected motors the advantage is distinctly on the side of electric driving. The service is not more severe than that demanded by tramway motors, and the conditions should be as readily fulfilled.

Smoke Prevention and Public Health.

IN the recent issue of the *Journal of the Sanitary Institute* there are two papers dealing with the question of smoke prevention from the view-point of the effect upon public health, which demand attention as falling within the province of the engineer. A paper by Mr. E. A. Brayley Hodgetts opens by the positive statement that "smoke is a preventable nuisance, a danger to health, a national waste, and that it should therefore be prohibited." This is strong language, but not altogether unjustified. All life depends upon the light and heat of the sun, but "it has been reserved for so-called civilised peoples to produce artificially and at great cost, clouds composed of sulphurous vapours and small particles of carbon to hide the sun from them, and cover the places where they live with a pall which keeps out the light, arrests vegetation and interferes with the functions of the respiratory organs."

The pollution of the air by smoke is as

injurious as, or even more injurious than, pollution of air or water by sewage or natural impurities, since the latter but breed epidemics which reveal their origin and can be combatted, while the wholesale poisoning of the air by coal products, and the consequent obscuration of the sun and absorption of oxygen, is a direct danger to every individual, and if permitted to go far enough would doubtless result in the final extinction of the human race. The influence of smoke upon public health is shown in the fact that there is no record of smoke-producing towns keeping up a natural increase in the population, the increase in the population of cities being maintained at the expense of the country.

Mr. Hodgetts does not go into the question of methods of smoke prevention, confining himself rather to the necessity of education of the public as to the danger of smoke pollution, urging also an impartial enforcement of the law upon rich and poor alike.

The second paper, by Dr. Joseph Priestley, is hardly as radical as that of Mr. Hodgetts, since, while affirming the injurious effects of coal smoke, he admits that a certain amount of it is not preventable.

After reviewing the legislation which has been made concerning the regulation of smoke production, Dr. Priestley shows that the matter legally hinges upon two points; namely, the degree of intensity which constitutes *black* smoke, and as to what constitutes reasonable precaution against the production of black smoke. As at present construed the production of black smoke renders the producer liable to fine, notwithstanding the fact that the furnaces may have been fitted with the most improved appliances for smoke prevention and the smoke may have appeared for but a few minutes. Since Dr. Priestley is of the opinion that the practically perfect smoke-prevention appliance has yet to be introduced, such an enforcement of the law appears to him to savour of persecution.

"All smoke cannot be prevented except by shutting down all factory and workshop fires; and recognising the difficulty of consuming smoke when once formed, it follows that prevention is better than cure, and such prevention consists in frequent and careful light stokings, with or without mechanical appliances, and the use of suitable fuel—sufficient boiler power being, of course, a *sine qua non.*"

It must not be forgotten that the degree of blackness of smoke indicates only the quantity of solid carbon present, and that a very small amount of solid carbon is sufficient to produce a high degree of opaqueness. The injurious sulphurous gases are themselves nearly or quite colourless, but at the same time the blackness of the smoke is a fair indication of the degree of imperfection of the combustion, and hence of the production of deleterious gases. Anything, therefore, which reduces the blackness of the smoke may be considered as an improvement in the combustion, and consequently much to be desired.

The whole subject is one which should be considered from the two standpoints of public health and industrial prosperity. It is now generally conceded that smoke prevention does not necessarily mean fuel economy, and that manufacturers cannot expect to realise any great saving by preventing the production of smoke. The matter must rest upon the degree to which manufacturers should be prevented from polluting the air we breathe, as they are now generally prevented from polluting the water we drink.

The Breakage of Propeller Shafts.

AMONG the papers presented at the recent meeting of the Institution of Naval Architects, one of the most important was that by Mr. A. Scott Younger upon the corrosion and failure of propeller shafts.

The increasing frequency of shaft breakages is a matter of common knowledge among marine engineers. During the period between the months of January and July, 1899, eighty-three casualties occurred to shafts and propellers of classed vessels, and of these only 10 per cent. were due to accidents to propellers. Of the remainder, the accidents to propeller shafts were 50 per cent. more numerous than those to all other kinds of shafting together. This applies only to British vessels, and according to another reliable authority, there were during 1899 nearly 250 cases of accidents to the shafting and propellers of steamers of all nationalities.

Mr. Younger starts out by stating that

his object is to account for the extreme corrosion which occurs at the ends of the brass liners on tail-end shafts, this being one of the commonest causes of shaft breakage. The general arrangement of a tail shaft is with two bearings, sheathed with brass or gun-metal liners, and corrosion of the shaft is found to occur at the inner end of the outer liner and the outer end of the inner liner, breakages frequently occurring at one or the other of these points.

"While all writers are agreed that corrosion occurs just at the ends of the liners, there is not the same agreement among them as to the cause. It has been said by some to be wholly due to galvanic action. Others say that the corrosion is due to galvanic action plus the vibration and shock set up by the propeller in striking the water. Others again have adopted the theory that the water at the ends of the liners has a sawing action which gradually wears away the shaft."

Mr. Younger gives a detailed examination of the stresses produced in a shaft in a typical case, using a graphical method for ascertaining the bending movement at various points in the shaft. Although the bending movements thus deduced are not excessive, yet it must be remembered that the first business of the shaft is to transmit a twisting movement, and that the bending movement is subsidiary; hence these stresses become of extreme importance.

In order to give the theory a practical trial, Mr. Younger constructed a series of model shafts, which were placed in a lathe and revolved while under the action of bending moments. A careful record was kept of the time required to fracture each shaft. Some of the shafts were straight, of uniform diameter, others were enlarged at the parts passing through the bearings. The results showed that the shafts broke at the points where the diagrams indicated the severest stress, and that the plain shafts showed greater strength, running four to five times as long as the shouldered shafts. There appears to be no doubt whatever that any sudden change in the cross-section of a shaft is an element of weakness, even when the change is an increase in diameter. A number of devices have been made to provide a suitable and effective stern-tube fitting without the use of liners, some of these being illustrated in Mr. Younger's paper.

The general conclusions drawn in the paper are that there are three methods in which the question of the prevention of shaft breakages may be treated. The first is to increase the diameter of the shaft to a point where the stresses arising from the bending action become negligible. In most cases this would involve an increase of about 15 per cent. in diameter, although the weight of the propeller and the speed of the ship would have to be taken into account.

The second method consists in reducing the bending moment on the shaft, either by the use of an outer bearing, by a reduction in the weight of the propeller, or by an increased quantity of water ballast to insure a deeper immersion of the propeller.

The third and last method is to arrange the material in such a way that the section of the shaft is continuous, thus doing away with the localising of the stresses at particular points. The only satisfactory way to do this is to abolish the liners altogether, and then fill the stern tube with tallow or oil to prevent the bearings from rusting.

The general opinion in the discussion of Mr. Younger's paper was that stronger shafts were a necessity. Propellers have been growing heavier all the time, larger diameters being used than formerly, and larger diameter shafts should follow.

The question of the immersion of the propeller is also a very important factor in shaft breakages. The practice of sending vessels to sea with the hub of the propeller awash is doubtless responsible for many tail-shaft breakages. It was suggested that there should be a minimum as well as a maximum load-line, and that a ship should not be permitted to go to sea unless her propeller was immersed.

Stern-post bearings are not likely to come into use, and would prove of more harm than good if they were used. The action of the rudder will deflect the post and throw additional stresses on the shaft, increasing the liability to breakage. The true remedy is to provide sufficient strength in the shaft to resist all the stresses which are liable to come upon it, and the increased cost involved in doing this will prove economy in the end.

Power Used in Machine Tools.

DURING the past few years considerable attention has been given to the operation of machine tools by electric motors, and the principal advantages of this system are well recognized. There is no power consumed by long lines of shafting, there are no small steam engines with low efficiency, each tool is supplied with just the power it needs, and when idle wastes no energy.

Under the older systems there is generally only a vague notion of the power needed to drive a machine under various conditions, but with an electric motor this difficulty disappears, for it is possible at any instant to measure exactly the energy used by the motor. Some experiments at the Atlas Works, Sheffield, were reviewed from the *Engineer* in our May issue, and in a recent number of *Glaser's Annalen*, Herr Loch gives some interesting statistics of the main railway shop at Gleiwitz.

In this shop there are 107 electric motors of various sizes used for running tools and other machines. When the machines were bought it was found that the makers themselves were generally ignorant of the power required to run them, and so there were some mistakes made in choosing suitable motors, some being too weak and some too strong for the work they were called upon to perform. When overloaded, the motors heat up very much and often stand in need of repairs; and it is not sufficient for them to be able to carry the ordinary loads, but they must also be able to bear the extra loads at the starting of the machines. The current used at starting is from one and a half to three times that required under normal conditions, the added amount depending partly upon the masses to be set in motion and partly upon the care with which the starting resistances are switched in. Motors which are larger than necessary have no drawbacks except the enhanced first cost, as their efficiency falls off but little when not fully loaded.

A great many measurements were taken at Gleiwitz to determine the proper size of motor to run the various machines, and there is a list of fifty-seven tools, with their corresponding motors, in the original article, to which the reader is referred.

Among other results, it was found that a planer with a working surface 300 x 100 centimeters needed a 5-horse-power motor, while another one, 160 x 85 centimeters, took 3 horse-power. A shaping machine, with a 30 to 40 centimeter stroke, used 2 horse-power, the same as a circular saw 50 centimeters in diameter, while small and medium lathes required 1 to 2 horse-power. A horizontal milling machine was satisfied with 1 horse-power, borers and drills of various styles and sizes needed from 1 to 6 horse-power, emery wheels, 2 to 4 horse-power.

The electrical measuring instruments give an exact account of the power consumed at every stage of the operations. The machines can be observed at starting, when running unloaded, at various speeds and under all conditions, and it is frequently found that the useful work done requires only a fraction of the total power consumed by the machine. By comparing the power consumption of similar machines when unloaded, one can draw interesting conclusions as to their condition, the care with which they are maintained, and the suitability of their construction. The no-load power consumption of car-wheel lathes of different makes varies, for instance, from .63 to 1.9 kilowatts.

The reversal of the motion or the quick back-stroke of the working parts often demands the greatest outlay of energy, in the wood-planing machines, for instance, requiring more than the working stroke.

The influence of different speeds on the power consumption is shown by the following example: A shaping machine required 1.7 to 2.3 kilowatts at starting. When running empty it used:

At 10 strokes per minute and 18 centimetres length of stroke, .46 kilowatts.

At 16 strokes per minute and 18 centimeters length of stroke, .53 kilowatts.

At 24 strokes per minute and 18 centimeters length of stroke, .59 kilowatts.

At 38 strokes per minute and 18 centimeters length of stroke, .85 kilowatts.

At 38 strokes per minute and 10.5 centimeters length of stroke, .63 kilowatts.

At 38 strokes per minute and 30.9 centimeters length of stroke, 1.38 kilowatts.

When working with a 4-millimeter cut, at 16 strokes per minute and 18 centimeters length of stroke, only 0.85 kilowatts was consumed.

There are also given results with various other machines, which can only be referred to here.

The 107 motors in the main shop have a combined output of 334.5 horse-power, and require 331 kilowatts at their terminals, or 347 kilowatts, including the loss in the conductors leading to them. If all the motors had been made large enough for their work, they would have had an output of 454 horse-power, and the corresponding consumption of energy would have been 426 kilowatts, or 461 kilowatts including the line drop.

When running under normal conditions, the motors use, on an average, from 250 to 450 ampères, at 220 volts—that is, from 55 to 99 kilowatts, including the conductor losses. The total energy consumed per month is about 15,000 to 20,000 kilowatt-hours. From these figures it follows that the average load of all the 107 motors is only from 16 to 29 per cent. of their normal capacity.

The Physics of the Coherer.

THE coherer—the essential part of the receiving apparatus in space telegraphy—operates in accordance with the well-known fact that its conductivity is altered when electric waves strike it. With the substances in ordinary use for coherer filings, the conductivity is increased by the impact of the ether waves, and though the exact nature of this increase is unknown, it is generally believed to be ultimately due to some molecular or atomic changes.

Experiments recently made by Joh. Härdén, and described by him in the *Elektrotechnische Zeitschrift*, seem to show that before we reach the ultimate explanation, there is a simple mechanical one, adequate as far as it goes. Herr Härdén made a microscopic examination of the action of the coherer, and in order to do this effectually, he discarded the ordinary tube filled with filings, and used two finely pointed steel wires instead. These were placed in circuit with a galvanometer and a small battery. The points of the wires were situated in the field of the microscope and the distance between them was regulated by means of a micrometer screw. The transmitting apparatus was placed in the focus of a parabolic reflector, so as to concentrate the issuing waves on the receiver. Under the influence of these waves, sparks began to pass between the steel points of the "coherer" when separated by a distance of 0.3 millimeter, but the galvanometer showed no deflection. As the points were brought closer together, the sparking grew more active, until, when they were 0.006 millimeter apart, a distinct, dark bridge was suddenly formed between them. With a magnifying power of 300 diameters it could easily be seen how small metallic particles were torn from one point and carried over to the other while the sparks were passing. At the instant when the bridge was formed, all sparking ceased, and the galvanometer showed a deflection corresponding to about 150 milli-ampères. This deflection remained pretty constant as long as the bridge lasted; it changed by a few scale divisions when stronger impulses were sent out by the transmitter.

As soon, however, as the steel points were lightly shaken, the bridge between them was destroyed, and the galvanometer needle went back to zero. The whole process was repeated whenever new electric waves struck the coherer, and in every case the galvanometer deflection was about the same.

These experiments furnish pretty conclusive proof that the little sparks excited by the impact of the electric waves carry over minute metallic particles from one point to the other, and when the distance is not too great these particles form a bridge, which is then used by the battery current. The experiments also showed

that in working coherers it is of particular importance to have the breaks between adjacent points or filings as small as possible, for otherwise no bridges can be formed.

One of the greatest faults of coherers has been their unreliability. A coherer will work very satisfactorily for a while, and then, without any apparent reason, it will work very badly or even not at all.

In order to overcome this defect, an arrangement which gave very good results was tried in the course of some wireless-telegraphy experiments near Brest. As described by M. C. Tissot, in a note in the *Comptes Rendus*, the modification in the receiving apparatus consisted simply in placing the coherer in a magnetic field with the lines of force parallel to the axis of the tube. The filings in the tube must be of some magnetic substance—steel of different kinds, nickel, or cobalt. The electrodes may be either of a magnetic or of a non-magnetic metal. The general results are about the same, whatever be the means resorted to for creating the magnetic field. For instance, the electrodes themselves may be of steel feebly magnetised, or they may be of soft iron surrounded by a coil of wire, or a separate permanent magnet may be used.

A convenient method for observation is to use non-magnetic electrodes and to place the entire tube between the pole pieces of an electromagnet, feebly excited.

By this means it is possible to increase greatly the distance between the electrodes without lessening the sensitiveness of the coherer. In ordinary tubes, the electrodes are from 0.5 millimeter to 1 millimeter apart, but when placed in a weak magnetic field, this distance can be increased to 6 or 8 millimeters without diminishing the sensitiveness. The most valuable effect of the magnetic field, however, is to keep the sensitiveness constant, so that the coherer will work with steady reliability.

Commerce Destroyers.

In navies, as in other earthly things, fashions change from time to time, and whereas there was a boom in commerce destroyers a few years ago, nowadays heavily armoured vessels are all the rage. There is one peculiarity about naval fashions, though, which is that as it takes a couple of years to build and equip a modern man-of-war, a ship may be out of fashion by the time it is ready for service.

This seems to be the case with two new French vessels, the Guichen and the Chateaurenault, which were begun while the "corsair cruiser" fashion was on, but which are now severely criticised, although it is acknowledged that they are very good examples of their type. It is the type which at present is thought to be at fault, and in the French naval programme recently issued there is no provision made for any unprotected or even lightly protected cruisers.

According to *Le Yacht*, the Guichen and Chateaurenault are vessels of a little more than 8,000-tons displacement. Each carries a rapid-fire battery consisting of two 16.47 centimeter, six 13.86 centimeter and ten 4.7 centimeter guns. The hulls are unarmoured, but there is a protective deck and light armour about the 13.86 centimeter battery. The Guichen has shown a speed of 23.55 knots on her official trial trip off Toulon, and it is confidently expected that her sister ship will reach at least the 23 knots required by the contract with her builders.

But it is claimed that these ships cannot maintain this speed in active service, and that they will never be able to overhaul the first-class ocean liners. It is pointed out that the Columbia, which did 22.8 knots on her trial trip, could make only an average of 18.16 knots on her homeward voyage from England, whereas many of the merchant greyhounds average more than 20 knots, year in and year out, while the best of them already go above 22 knots in every-day service.

The commerce-destroying activity of these naval corsairs will then be confined to the slower passenger boats and the freight vessels. But it is said that this work can be done just as well by ships which, if a little slower, are able to give and take hard blows and can defend themselves when they meet an enemy.

All the great maritime nations now have fleets of subsidised merchant vessels which in time of war can be armed and converted into auxiliary cruisers. It is thought that some of these ships would be able to give cruisers of the Guichen

class a pretty stiff fight and might even beat the commerce destroyer. When warships have no strong points except their speed, they become antiquated in a short time. The fast cruisers of a dozen years ago could hardly escape from a battleship of the latest type, and a commerce destroyer than can neither catch its prey nor run from its enemies is in a pretty bad way.

At present the fast armoured cruiser is considered to be the type that combines the greatest number of advantages. A 23-knot vessel like the Jeanne d'Arc, for instance, can prey upon the enemy's commerce, can beat protected cruisers, can bombard shore batteries without great risk, and can even measure her strength with battleships. It is true that the cost of such a great cruiser is enormous, but in this case, as in many others, it is probable that the best will prove to be the cheapest in the end.

The Trans-Sahara Railway.

In the partition of Africa, France has acquired an enormous district, which differs from the British and German spheres of influence in being much more compact. It stretches from the Mediterranean on the north to the Congo River on the south, from the Egyptian Soudan on the east to the Atlantic on the west, and with the exception of Morocco and the British and German possessions on the Gulf of Guinea, almost all the territory included within these wide limits is under the dominion of France.

On the northern edge of this area are Algiers and Tunis, on the western and southern, Senegal, French Guinea, the Ivory Coast, Dahomey and French Congo, while the interior of this vast region is divided into two parts: the Sahara, to the south of Algiers, and the Soudan, between the Sahara and the equator.

It was long believed that the Sahara was a frightful desert, void of all animal and vegetable life, and that, on the contrary, the Soudan was a marvellous country, of unexampled fertility; but the reports of travellers who have visited these regions have given us juster ideas concerning them.

The Sahara, it is true, has arid regions, bare plateaus and sandy mountains, but it also contains many cultivated and inhabited oases, where the date-palm flourishes, and it is reasonably certain that with the aid of artesian wells these fertile areas can be largely increased.

The reports about the Soudan are less concordant. It is known that districts about the upper Niger and the upper Senegal are rather poor, while the central Soudan between the Niger and Lake Tchad is a fertile country, but there is very little information about the regions bordering Lake Tchad on the north and east.

The war in South Africa, and the recent occupation by the French of In-Salah, a place in the Sahara south of Algiers, have, according to M. G. Leugny, who writes in *La Revue Technique*, aroused fresh interest in a project which of late years has been rather neglected—the Trans-Sahara railroad.

As far back as 1880, some preliminary surveys to the south of Algiers were made by exploring parties, but the disastrous end of the expedition commanded by Colonel Flatters, which was ambushed and nearly exterminated by the Touaregs, put a stop to this work for many years. But now there is renewed interest in the matter, and a Paris newspaper, the *Matin*, is sending out an expedition to complete the work of Flatters.

The southern portions of the French African empire are practically isolated at present, the vast interior regions presenting an almost insurmountable barrier between them and Algiers, so that in case of a war with a strong naval power like England, they would be in great danger. But Algiers is comparatively near France and possesses, moreover, its own means of defence, so that if it and the other parts of French Africa could be firmly knit together by a railroad there would be little to fear from an outside foe.

Besides these strategic reasons in favor of a Trans-Sahara railroad, there are political and economic ones as well. Such a road would bring the different parts of the country into touch with one another and would greatly facilitate their economic conquest.

Algiers possesses a railway system, some of whose branches already touch the confines of the Sahara, and the question now to be decided is: From what point shall the new road take its departure? Biskra, already connected with Philippeville on the

Mediterranean by a line through Constantine, seems to be the place most favored. From here the road would run almost due south to Timassinin and Amguid, about 1,100 kilometres from Philippeville, and on the watershed between the Mediterranean and the Niger. At Amguid the road would divide, the main line going east of south toward Lake Tchad, and a branch running southwest to Bouroum, at the bend of the Niger. As far as the watershed there seem to be but few engineering difficulties. For long stretches there is a grade of only one-tenth of one per cent., and the divide can be crossed at an altitude of 650 metres.

There is but little positive information about the southern slope toward the Niger and Lake Tchad, but for the present most attention will be paid to the northern section of the road as far as Timassinin and Amguid, which are important markets and caravan stations. It is estimated that this section could be completed in two years.

As to the amount of traffic that can be counted on, it is pointed out that the inhabitants of the Sahara get their supplies from Tripoli. Now the cost of transporting a ton of merchandise on camel's back from the latter city to In-Salah, in the Touat region, is from 1,300 to 1,400 francs, and the journey takes from forty-five to fifty days. If the railroad were built, Timassinin could be reached from Philippeville in three or four days, and a ton of freight could be transported for about 60 francs. Freight for In-Salah would have to be forwarded by camel from Timassinin at a total cost of 550 francs by this route, against 1,300 francs for the all-camel line. This difference would necessarily make Timassinin a great center of trade in the Sahara, and, as the road is extended southward it will tap other caravan routes and build up a large import and export business, the total receipts being estimated at 6,265,000 francs per annum.

When the road reaches the Soudan it will make an outlet for the rich products of that region, some of which are ivory, ostrich feathers, gold dust, hides and leather, india rubber, coffee, cocoa, pepper, palm oil, and precious woods.

The length of the main line from Biskra to Lake Tchad will be about 3,100 kilometres, and it is estimated that receipts amounting to 10,000 francs per kilometre, £620 or $3,100 per mile, can be counted upon from the total freight and passenger traffic of the Sahara and the Soudan, while it is claimed that the fixed charges and operating expenses will be only 2,500 francs per kilometer—£155 or $775 per mile.

A New Electro-Graving Process.

HERETOFORE, the process of etching metals, either chemically or electrolytically, has consisted in covering the parts which were not to be acted upon, and then allowing the chemical or electrolyte to etch the uncovered portions. In this way all the uncovered parts are etched to the same depth, and if we wish to have differences, the process must be repeated, those portions which have reached the desired depth being now protected and the etching agent allowed to act on the remainder.

But it would be almost impossible by this means to make a hard metal die with curved surfaces, and even after many re-coverings and etchings it would be necessary to finish the work by hand.

It has been reserved for Herr Josef Rieder to surmount the difficulties of electro-graving steel by a very ingenious process, which he describes in the *Elektrochemische Zeitschrift*. He uses as an electrolyte an ammonium chloride solution, in which there dips a block of plaster of Paris having a design, in relief, on its upper face. Under the plaster block, in the electrolyte, there is a coil of wire which serves as a cathode. The steel plate which is to be etched rests upon the relief on the upper surface of the plaster, and is connected with the source of current so as to form the anode. Now when the electrolyte has filled the pores of the plaster, it can be said that the steel plate rests upon a liquid surface in relief. It can also be seen that the plaster as a rigid body prevents the pressure of the steel plate from altering this liquid surface, and so the plate and the liquid can be in contact only at the highest point of the relief.

If now the current be allowed to pass, chlorine will be set free at the anode, where it will combine with the iron in the plate, the resulting chloride then dissolving in the electrolyte. At the places where the steel plate touches the plaster it is gradually eaten away and settles down so that more points come into contact with the plaster

and electrolyte, the etching thus going on over an increasing area. The first point of contact, corresponding to the highest part of the plaster relief, will be the most deeply etched, and the whole process will be finished as soon as all the points of the etched surface touch the plaster model.

This seems comparatively simple, and so Herr Rieder thought when he began his experiments, but it took three years of continuous labor to reduce his ideas to a practical working basis. His first apparatus was a rough one. He took a block of plaster of Paris with a cast of a coin on its upper surface, saturated it with a ten per cent. solution of ammonium chloride, placed a steel plate on top and turned on the current. But in a short time the first difficulty presented itself. How could the progress of the etching be ascertained? Only by taking off the plate. But if the plate were removed, it would be practically impossible to restore it to exactly the same position it first occupied, and by any inaccuracy in replacement the etching would be spoiled.

He guessed that an hour would be about right, but when he removed the plate, a black pasty substance covered the surface of contact and only after this was cleaned off, could there be distinguished an etching which by a large stretch of imagination might be called the relief of a coin.

In the first place, then, some arrangement had to be made by which the plate could be lifted off the plaster model from time to time and replaced exactly. This was effected by taking a board with a hole in which the block of plaster was exactly fitted, and placing the steel plate in a wooden framework secured to the board.

This difficulty having been removed, further experience soon brought up some other points.

The carbon and other insoluble substances contained in the steel have to be removed from the plate mechanically every little while, as they appear in the form of a powder between the model and the plate and make the fine work impossible. The intervals at which this cleansing has to be done depend largely upon the percentage of carbon in the steel.

At the working surface of the plaster, the chlorine, which is the effective etching agent, is rapidly consumed, and the diffusion from the electrolyte through the pores of the block is not great enough to supply the waste. In consequence it was found necessary, whenever the plate was lifted to remove the carbon, to apply some fresh ammonium chloride solution to the plaster model with a soft brush. In order to do rapid work the current density has to be kept as high as possible, and for this reason it was found advisable to make the etching periods between the plate cleansings and applications of solution to the model not longer than twenty seconds.

Another difficulty was caused by the breaking or wearing out of the plaster model before the etching was completed, and this was overcome in two ways, first, by making the plaster more durable, and, second, by making use of several accurately interchangeable models.

The process, as described thus far, required constant personal attention, and the next step was to devise an apparatus which would perform all the mechanical operations automatically.

It took a long time to contrive such a machine, but success was finally achieved with an apparatus which works in the following way:

The plaster models are fastened in a cast-iron frame and rest upon a table which is movable vertically by means of an eccentric. Above this table there is a support holding the metal plate to be etched. This support can also be moved up and down and can be adjusted so as to be exactly parallel to the model. Behind the table which carries the models, there is a carriage with a rotary brush. The mechanism is so arranged that the plaster model is gently brought into contact with the steel plate and allowed to remain there about fifteen seconds, when it is temporarily lowered, the brush runs over the surface of the plate and removes the insoluble powder, and at the same time a sponge moistens the surface of the model with a weak solution of hydrochloric acid, which, for various reasons, was found preferable to ammonium chloride for this particular purpose.

This method of making steel dies has now proved a complete practical success, and Herr Rieder will have one of his machines as an interesting exhibit at the Paris Exposition.

The Hennebique Iron-Concrete System of Construction.

SOME years ago, M. François Hennebique, at that time living in Brussels, was called upon to build an absolutely fireproof country house. Shortly before this there had been a large fire in which a so-called fireproof warehouse, constructed of stone and iron, was completely destroyed. This convinced M. Hennebique that it was not alone sufficient to dispense with wood in constructing a building, but that the iron work would have to be protected against fire by a suitable covering. This consideration, together with the desire to build as economically as possible, led to the idea of making the floor beams of iron imbedded in concrete, with a comparatively thin concrete floor. Already recognising the fact that the metal in the beams would be subjected to a tensile stress only, he used iron rods for his longitudinal members, with some flat cross pieces.

This was the germ of the system, which has since then had a wide development, particularly in France and the neighbouring countries, and at the Paris Exposition this construction has been employed in work to the amount of three million francs.

As a good deal of attention has recently been given to this system in Austria, Herr Ed. Ast was led to read a paper on the subject before the *Oesterreichische Ingenieur- und Architekten-Verein*, which is printed in the official organ of the society, and from which these extracts are made.

If we take a concrete floor supported on four walls and reinforced by concrete ribs on its under side, we find that, when loaded by its own weight or in any other way, it will be subjected to compression, tensile, and shearing stresses. Now, it is well known that concrete can stand great pressure, but that it offers comparatively little resistance to pulls, and so it has been the object of the designers of the Hennebique system so to dispose the iron as to strengthen the concrete at the proper points and take up the tensile and shearing stresses.

Some of the details from the Grand Palais des Beaux-Arts at Paris show very clearly how this construction is carried out. We find there a floor with a span of 9.78 meters, which is extended beyond its support on one side to form a gallery floor about 3 meters wide. This floor is designed to carry a load of 550 kilogrammes per square meter, or 110 pounds per square foot, exclusive of its own weight, at a cost of 25.10 francs per square meter, 1s. 10d. or 45 cents per square foot.

In every beam of this floor are imbedded four iron rods. They lie in pairs in two vertical planes. The lower ones, which have to take up the principal part of the tensile stresses, are straight, while the upper ones are bent in such a way as to perform some special functions. Flat iron straps run from the straight to the bent rods. Near the supports these straps are closer together than in the middle of the beam. Both rods and straps are loosely laid in, the only binding material being the concrete. The ends of the rods are preferably bent into a hook shape.

If we conceive the floor to be divided by planes midway between and parallel to the ribs, it will consist of a number of T-shaped beams. Whether freely supported, or with fixed ends, each beam will be so strained at its middle point that it will be in tension at its lower and in compression at its upper surface. The neutral axis, as a rule, will lie near the surface, where the rib joins the floor proper. The T-shaped section will thus be adequate for taking up the compression, and it only remains to provide for the tensile stresses. At the point of greatest positive bending moment, the two iron rods in a vertical plane are close together at the lowest part of the rib, so that all the metal is most efficiently disposed at the greatest possible distance from the neutral axis.

If we suppose the beam to have fixed ends, there will arise negative bending moments at the supports, which will cause tension in the upper part of the beam and compression in the lower. But this is also provided for, as the bent rod runs horizontally near the upper surface of the beam in the neighbourhood of the supports, and, if necessary, can be reinforced by another rod at this point to take up any extraordinary tensile stresses. The flat straps take up the transverse tensile strains which arise in the interior of the beam, and so increase in number toward the supports.

Floors constructed on the Hennebique system are less subject to vibration than those built in other ways, and their elastic deflections are only one-third as great as

with iron construction of the same capacity. These concrete floors can be covered with any kind of flooring material desired, and they offer no refuge for any vermin.

Hennebique structures are wonderfully durable and absolutely fireproof. This was shown by some experiments made at Ghent, where a small pavilion was built having two rooms, one on the ground and one in an upper story. The floor between the two, the walls, and the roof, were all constructed on the Hennebique system. The floor carried a load of 1,500 kilogrammes per square meter, or 300 pounds per square foot, the flat roof 1,000 kilogrammes per square meter, or 200 pounds per square foot. A fire was kindled in the lower room, the temperature there reaching 1,000° C. After a lapse of ten minutes the floor, under the influence of its load and the heat, showed a deflection of 0.5 millimeter, and after one hour, 13.5 millimeters. The walls then had cracks about 2 millimeters wide. The rise in temperature at the floor of the upper room was only 2° C.

After the fire had burned for one hour, it was put out; the cracks in the walls then closed up and the deflection of the floor disappeared as the structure cooled to normal temperature.

The cost of this system will depend upon the price of materials in different localities, but it can be said on the whole that where heavy loads have to be carried, it is more economical than any other, the saving in cost of construction sometimes being as great as 25 per cent.

The iron-concrete construction is used for a great variety of purposes—warehouses, private dwellings, public buildings, bridges, aqueducts and reservoirs, and even in harbour works. One of its neatest applications was at a three-story spinning-mill in Lille, where a Hennebique skeleton construction was used for the entire building, the façades of which consisted almost entirely of windows 4.28 meters wide, the intervening columns of iron-concrete being only 40 centimeters thick and the corner columns only 60 centimeters.

The Level of Lake Nicaragua.

In a recent issue of the *Scientific American*, Prof. Angelo Heilprin, F. R. G. S., F. G. S. A., presented a striking review of "An Assumed Inconstancy in the Level of Lake Nicaragua; a Question of Permanency of the Nicaragua Canal."

To this paper, which was referred to in these pages in connection with Mr. George A. Burt's article in the April issue of THE ENGINEERING MAGAZINE, Mr. C. Willard Hayes undertakes a response in the *National Geographic Magazine*.

Prof. Heilprin's presentation of his case is briefly as follows:

Elaborate measurements by American engineers during the past fifteen years fix the present elevation of the lake surface at 105 feet (approximately) above tide. Col. Childs, in 1851, fixed ordinary high water at 111 feet 5 inches above low tide in the Pacific. Lieut. Baily's level, run in 1838 "with great care and attention by a good theodolite during a period of four months," and "particularly commended in the earlier discussions of the canal problem," placed the surface at 128 feet 3 inches above low water on the Pacific side, while the Spanish engineer, Galisteo, in 1781, made the altitude still 5 feet higher, or 133.11 feet. It is, indeed, in Prof. Heilprin's language, "difficult to understand these discrepancies in values or to assume that competent engineers should have erred over such short distances of measurement to the extent of twenty per cent. of their results; yet the concurrence of the newer results of measurement leaves no room for doubt that either Baily's and Galisteo's determinations were faulty or there has actually been an abasement of the lake level since these measurements were made."

Prof. Heilprin, finding it difficult to accept the former of these alternative explanations, adduces additional evidence suggestive of "an actual abasement of the surface, and not merely a fluctuation dependent upon the hygrometric condition of the atmosphere." Such evidence, he thinks, is afforded by the conditions noted in the northwestern extremity of the lake—the Estero Panaloya. Baily, in 1838, and Squier, in 1849, found free navigation, with 5 to 15 feet of water through the Estero and only about four miles length of channel between Lakes Nicaragua and Managua. Col. Ludlow (1895-6) states that the lakes are separated by twenty-three (?) miles, and that, in the dry season at least, the Estero is dry, any water finding its way into it from the smaller lake disappearing through fissures in the bed. Again, the discharge of Lake Nicaragua—the San Juan River—appears, from the reports of different observers, to have undergone great change. Squier, in 1850, compared it to the Hudson or Connecticut, and described it as being, for "far the greater portion of its length, capable of being navigated by our largest river steamers." Collinson, in 1867, reported to the Royal Geographical Society that it was "so low that small stern-wheelers, drawing when laden only 10 inches of water, could hardly grope their way from rapid to rapid, and were finally stalled by the swift boulder-charged current." He "gives emphatic testimony to the lowering of the level of the lake, and suggests—what is not unlikely to prove the true explanation of the phenomenon—that it may be due to increased potentiality of the outgoing or draining waters incident to a differential rise of the land surface." He says: "Every year it becomes more evident to all living on its banks or using its stream that the flow of water is becoming less in the San Juan; and even the least observant native, dwelling on the lake, will tell how its banks are rising year by year visibly before his eyes, how the River Panaloya connecting the two great lakes is becoming drier every season, so much so that at times lately no water connection has existed between them."

Prof. Heilprin calls attention to the point that: "The Baily survey was made in the interval of time between the catastrophic eruption of Coseguina (1835) on

the northwest and the very violent one of Irazú (1841) on the southeast, and it was also about this period of special excitability of the crust that, as Squier reports, Nicaragua suffered most from earthquake visitations. It was in May, 1844, when the city of Nicaragua itself suffered much, that the waters of the lake 'were observed to rise and fall with the throes of the earth.' Naturally, it is to a period of this kind that one would look for most rapid or permanent terraine displacements." He calls attention to remarkable and indisputable changes in the level of Lake Ilopango, Salvador, in 1879-80, and to the point that Ilopango and Nicaragua are "hardly less than close neighbors of one another," and is disposed to believe that:

"1. The level of Lake Nicaragua is inconstant.

"2. The surface has dropped 15 to 20 feet in the period of little more than half a century."

From this conclusion Mr. Hayes dissents entirely; it is only "to one not familiar with the investigations which have been carried on in this portion of the isthmian region," he thinks, that "the conclusions reached by Professor Heilprin seem to have some foundation." His own line of argument in rebuttal is essentially an attempt to demonstrate, on purely physiographic grounds, that the assumed abasement of level could not have taken place.

Mr. Hayes says: "Three causes, singly or in combination, might bring about a change in altitude of the lake surface: (1) A depression of the whole of this portion of the isthmus without warping; (2) a depression of the lake basin by warping, the sea margins remaining constant; (3) a cutting down of the lake outlet." It will suggest itself to most minds that a fourth, and much simpler, cause might be the very obvious one of deficiency of the supplying waters.

The first is quickly disposed of by the known stability of the coast line on both Atlantic and Pacific sides. Gradually-sloping delta planes would quickly reveal any subsidence, by long invasions of the sea. A recent subsidence of a few inches near Corinto, northwest of the Nicaragua-Managua basin, was quickly recognized; "a depression of 20 feet of any occupied portion of the coast could not possibly escape notice."

The second hypothesis—local subsidence of the lake basins—Mr. Hayes considers untenable, because of the improbability that such a sinking could extend over an area 100 miles long by 45 miles broad without reaching the coast, only 12 miles away, or could proceed with such uniformity around the entire perimeter that evidences would not remain in the form of drowned shores or raised ancient beaches at divers points. Such evidences he does not find; "there is everywhere a nice adjustment of shore features to present conditions."

The third possible cause for a lowering of level—the cutting down of the outlet—Mr. Hayes thinks is removed from among the possibilities by the fact that from its point of issuance from the lake to the Toro Rapids (the sill maintaining the present level of the lake) the Rio San Juan "meanders through an alluvial plain just covered by the streams when in flood"—in other words, having "the character of a growing flood-plain"; it "represents a former extension of the lake silted up by tributary streams, but proves conclusively that the present relations have held for a considerable time." The "proof" seems decidedly imperfect. It certainly remains for Mr. Hayes to prove that this ancient lake bottom became exposed alluvial plain exclusively by silting up, and not in part by lowering of the lake. Indeed, one may well entertain the suspicion that even the Rivas "peneplain" is in part the lake bottom exposed through a shrinkage of the waters.

For the change in the Estero Panaloya Mr. Hayes finds possibly sufficient explanation in the transportation of sand by a strong littoral current, caused by the surf, and its deposit at the end of the Lake. An examination of the surveys made of this water nearly fifty years ago hardly permits of this interpretation, however. The comment of "the English engineer, Colquhoun" (Collinson ?) upon the diminishing flow of the San Juan is dismissed as coming from "a superficial observer whose conclusions were drawn from a relatively short period of observation." One would think that the shorter the period within which so very definite observation could be

made of the falling of the San Juan River and visible rising of the banks of Lake Nicaragua, the more pronounced and unmistakable the phenomenon must be.

On the whole, Mr. Hayes' paper leaves the impression that something more is needed to disestablish Professor Heilprin's conclusions. The known range of the lake levels within a few years has been 14 feet —though, by the way, Mr. Hayes' arguments run almost as strongly counter to these established facts as to the assumed further range of 20 feet—and it seems to demand more than an allegation of improbabilities or the marshalling of negative evidence to impugn finally the accuracy of the earlier surveys. Kingsley once said no one could deny the existence of water-babies till he had seen them *not-existing*, which was a very different thing from not seeing them exist. Perhaps it is true of "raised beaches" also.

The Steam Turbine.

THERE are probably few subjects in mechanical engineering upon which there is so little literature in proportion to the demand as in the case of the steam turbine. Possibly it is because the development has been, almost from the start, a commercial one. The experimenters have been naturally unwilling to give out imperfect results—still more naturally convinced of the inexpediency of making public property of conclusions which have cost them heavy expenditure of money, and many months of study and labor.

It has come to pass, therefore, that the Viper has made her surprising trial runs in England, and the stationary power-plant of turbines has been installed at the Westinghouse Air-Brake Company's works at Wilmerding, Pa., while the engineering world is still guessing at the exact construction of the interior of the Westinghouse-Parsons turbine.

An interesting general account of the latter installation is given in *The Iron Age*, with plans and elevations of the exterior of a 500-horse power and a 2,500-horse power turbine. Three units of the smaller size now furnish the entire motive power for the air-brake plant, the old engines having been completely removed. Each unit is direct-coupled to a 300-kilowatt two-phase alternating-current machine, the three being run in parallel.

A striking feature of the installation is said to be its compactness; although the machines "aggregate 1,500 horse power, yet, standing side by side, the space occupied is only 25 by 20 feet, although there is ample space for all purposes. The bed plate of each machine measures 16 feet 7 inches by 4 feet 3 inches. The whole plant, including two 10-horse power steam engines operating generators for exciter purposes, two pairs of condensers and air pumps, and the switchboard, occupies a space of only 29 by 30 feet. The foundations consist of ordinary brick piers, without any holding-down bolts, which are unnecessary on account of the absence of reciprocating parts.

"The speed of the turbines and generators is 3,600 revolutions per minute. The weight of each complete turbine and generator is 25,000 pounds. The turbines are designed for condensing the exhaust, which is accomplished by means of a combination of a pair of jet condensers and compound air pumps, in which the air and water are handled in separate cylinders. The vacuum is often as high as 28 inches, while the average barometer is 29.25 in Pittsburg. The delivery water is only a fraction of a degree different in temperature from that of the steam in the condenser. The thermal operation of these turbines is very striking, for although the live steam entering the turbines at 125 pounds' pressure has a temperature of about 350 degrees, yet the exhaust temperature at a point about four feet distant is only a trifle over 100 degrees, the exhaust pipe being cool enough to be handled comfortably. This is a remarkable exhibition of the transformation of heat into work, and the condensation must be slight, if any, or the closely fitting parts would not operate so smoothly at this high speed."

The moving parts of the turbine consist of a shaft carrying three drums of different diameters, increasing in steps like a cone-pulley. This revolves within a cylinder correspondingly enlarged in steps from inlet to exhaust end. On the interior of the cylinder and on the exterior of the shaft drums are fixed numerous rows of "guide

blades or curved vanes about three inches in height," disposed radially and so arranged that the rows on the drums fit between those on the cylinder walls. Through the annular space into which these vanes project the steam flows, being directed by the fixed blades so as to exert its maximum effect on the revolving vanes, and attaining increased degrees of expansion by passing into constantly enlarging spaces between the rows of vanes and between the individual vanes making up each row. "The turbine is thus a multi-expansion engine with as many expansions as there are rows of blades. The total expansion ratio between inlet and exhaust is 96 to 1."

The turbine is governed by intermittently cutting off the steam supply entirely for a longer or shorter period, according to the load. The governing is said to be extremely sensitive, and capable of adjustment within a fraction of 1 per cent. between full load and no load.

The 2,500-horse power turbine approaching completion at the Westinghouse Machine Company's works is said to be the largest unit yet attempted, two of 1,400-horse power being under construction in England for a German electrical plant. The shaft of the 2,500-horse power turbine, complete, will weigh 28,000 pounds. The diameter of its largest moving part will be 6 feet. It is to make 1,200 revolutions per minute with steam at 150 pounds.

Some interesting details of the shop methods employed in making these huge shafts and casings were given in Mr. Roland's illustrated article in the February issue of THE ENGINEERING MAGAZINE.

The Langen Monorail.

REVIEWING the Caillet monorail in these columns (January, 1898), the opinion was expressed that the Caillet system might find application on account of the modesty of its pretensions—it attempted nothing further than the establishment of a simple portable form of suspended industrial railway for goods carriage—but that the single-rail tramway, in competition with the ordinary system, had no *raison d'être*. The same view is repeated and emphasized in some of the journals which have recently published illustrated descriptions of the Langen suspended railway, now under construction and reported by the *Street Railway Review* to be half completed between Barmen and Vohwinkel, a distance of about 8 1-3 miles. The *Review's* account is based upon a consular report, while *Engineering News* has a translation, with commentary, from the *Zeitschrift des Vereines deutscher Ingenieure*. Rather important differences in the matter of figures of weights, measurements, and cost are apparent in the two accounts.

In Herr Langen's original experiments with a suspended-carriage railway he used a two-rail system and secured a speed of only 7½ miles an hour. A second attempt, with a single rail, was attended with better success and 15½ miles an hour were made. Thus encouraged, the owners of the patents proposed and secured permission to erect the pioneer service line under the system, in place of an elevated road for which the municipalities of Barmen, Elberfeld, and Vohwinkel were planning.

The road runs in part over the small river Wupper and in part over the highway. The supporting structure consists essentially of a series of light trusses, of varying span with an apparent maximum of 98 feet, carried on inclined posts over the river and on curved posts over the street. The rails (it is a two-track road) are of T section, laid on iron plates bolted to the supported spans, with a layer of felt interposed to reduce vibration and noise. One rail is carried on each side of the span, at the bottom, the width of the truss being sufficient to allow the cars to pass.

The cars, each of which is to carry 50 passengers, are suspended from two-wheel trucks, two trucks to each car, running on the T rails, and the form of suspending arm is said to be such as to prevent derailment. Between the two axles on each truck is a 36-horse power 500-volt electric motor, current being taken from a contact rail by a slip shoe. The braking system seems ample. A speed of 18 miles an hour, including stops, or 25 miles an hour maximum, is expected. The road is to be in operation early in 1901.

The *Review* and *News* agree substantially that the maximum grade is 4.5 per cent. and that main-line curves wherever possible are made with minimum radius of 300 feet; but the *Review* gives the mini-

mum radius on sidings as 27 feet, the weight of supporting structure as 838 pounds per lineal foot over the river and 783 pounds over the highway, and the cost as $200,000 to $225,000 per mile, including foundations and stations—while the *News* gives the minimum radius on sidings as 19 feet, the weight as 766 pounds per foot over the river and 715 pounds over the highway, and the inclusive cost as $172,000 to $192,000 per mile, these figures agreeing with those given in the German papers.

The *News* considers "that the swinging of the car in pendulum fashion, as it rolls along, might be so considerable as to make riding very uncomfortable for persons with a tendency to sea-sickness." As the experimental cars swung outwards on the curves, at an angle of 25 degree from the vertical, this supposition seems well founded. Altogether it is a curiosity of engineering, if not a "monstrosity not likely to be anywhere repeated."

Failure of the Austin Dam.

THE failure of the Austin (Tex.) dam, with attendant destruction of the power house and the loss of eight lives, has been treated at considerable length, especially by *Engineering News,* which had an excellent early telegraphic report and a later illustrated account, or rather series of accounts, by several eyewitnesses. These latter are of particular interest because they are by engineers—Dr. H. W. Chance and Prof. T. U. Taylor—who were on the spot immediately after the break, and the accompanying photographs furnish an almost continuous record of the accident up to the time when the flood had subsided. *The Engineering Record* gives a succinct history of the construction of the dam. It is noteworthy, however, that all the accounts are confined very closely to the records, and comment, deduction, or editorial opinion is almost entirely lacking.

The dam was 1,125 feet long on the overflow line, 1,275 feet on the crest, 66 feet through at the base, and 68 feet high above bed rock. It was of masonry throughout, with cut-stone faces and heart of heavy rubble masonry laid in cement mortar, the interstices being filled with concrete. It rested on limestone, which seems to have been rather unsatisfactory. A good deal of trouble was met with during construction from strong springs in the bed and the adjoining bluffs.

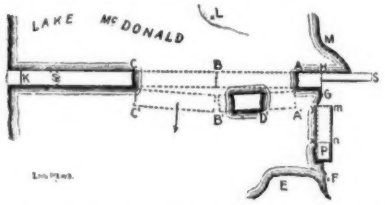
Mr. John P. Frizell made the original report and began the work as chief engineer in 1890; in 1892 the Austin Board of Public Works called in Mr. E. Geyelin and Col. J. T. Fanning, and shortly after Mr. Frizell withdrew and the work was contined under Mr. E. W. Groves, with Col. Fanning as consulting engineer. Important changes from Mr. Frizell's plans were made, particularly in the form of the crest and in the location of the power house, which was moved close to the dam instead of about 600 feet below, as proposed by Mr. Frizell. It is noteworthy, too, that while Mr. Frizell's drawings show four cut-off trenches in the bed rock, later sketches show but two; when the change was made is not apparent, but as the dam was about two-thirds completed when he withdrew, it would seem that it must have been under his regimé.

The following account of the failure is given to *Engineering News* by Prof. T. U. Taylor, Assoc. M. Am. Soc. C. E.; the accompanying sketch is reproduced.

"From 1 P. M., April 6, to 4 A. M., April 7, there was a rainfall of 5 inches at and in the vicinity of Austin, in a mountainous country, on ground already wet. In addition to this tremendous rains fell all along the Colorado and its tributaries from Austin as far up as Llano, a distance of over 100 miles. The Colorado rose rapidly, and by 10 A. M. Saturday (April 7) it was apparent that the dam was to withstand the biggest flood since water first wetted its crest on May 16, 1893. At this hour the water level of the lake was over 10 feet above the crest of the dam and was rising rapidly. The greatest previous flood height occurred at 9 P. M., June 7, 1899, when the lake level was 9.8 feet above the dam crest.

"At 11:20 A. M., April 7, when the lake level had reached a height above the dam crest of 11.07 feet, the dam gave way at B, about 300 feet from east end of dam. Observers at E, F and H all unite in their testimony that it first opened at B, as if the mad current had simply pushed its way through the structure. Sooner than it takes to write these words, the two sec-

tions A B and B C, each about 250 feet long, were shoved or pushed into the positions A′B′ and B′C′, about 60 feet from their former position in the dam. There was not the slightest overturning. After the warning break at B, the water over the part A B C was seen to rise several feet, and the next instant the pent-up water was pouring over the sections A′B′ and B′C′. At 11:30 the lake level fell to the crest of the dam, and the two sections A′B′ and B′C′ were seen to be upright, each still a solid mass, complete, unbroken, and intact (except for the scaling off of the granite facing from the down-stream face), occupying a position practically parallel to the dam. To the casual observer, the detached portions at this time had the appearance of having been erected in their new positions by the original contractor. The crests of A′B′ and B′C′ were about on the same level with their original position except at C′, which was slightly higher, giving B′C′ a slight longitudinal dip towards the power house. Measuring along the crest, the break left about 500 feet of the dam, K C, at the west end, and 83 feet, A H, at the east end, still standing unaffected.



"As soon as the sections were broken out and moved to the positions A′B′ and B′C′, the partially pent-up waters rushed through the gap, and that part held back by C K produced a strong current in the direction of the power house. The current struck the power house wall almost on a level with the pump-room floor (about 12 feet below the crest of the dam), crushed in all the windows on the west side, flooded all the lower stories, and caught and drowned five employees and three small boys. Two of the employees miraculously escaped by climbing through a belt hole in the dynamo room, *x y m n*. These workmen were pumping water from the lower portions of the power house.

"At 12 o'clock, 40 minutes after the break, the broken section B′C′ turned over towards the dam and disappeared beneath the torrent, and the eastern end of the section A′B′ was broken up and engulfed. This left about 100 feet, B′D′, which was shifted slightly out of its parallel position. This section, B′D′, was cracked from the crest as far down as could be seen. Sometime during Saturday night the smallest portion of this 100-foot section was swept away.

"At 12:05 A. M. Sunday, April 8, the northern two-thirds, *x y m n*, of the west wall of the power house gave way and fell, taking with it that part of the roof over the dynamo floor, and badly wrecking the corresponding part of the east wall."

We are informed that Mr. Frizell had contemplated the possibility of a flood of sixteen feet above the crest, whereas the break occurred with but eleven feet passing over. The curious feature is that there was no overturning—the dam as a whole seems to have slipped. We believe it has been generally considered that the frictional resistance secured by the weight on the foundation was enormously greater than any pressure which could be brought to bear.

Professor G. S. Williams has suggested a highly interesting explanation, which is, in brief, that the vacuum back of the fall, created by the falling water, became unusually high under the increased flow, and unbalanced atmospheric pressure was thus added to the weight and force of the stream itself. There was, we are informed, no provision for ventilating the space between the falling sheet and the lower face of the dam.

Fuller explanation of the contributing causes and exact accounting for responsibility are yet to be made. We may quote once more from *Engineering News:*

"In July, 1893, Mr. E. W. Groves, the engineer in charge of the dam after Mr. Frizell's resignation, also resigned. He gave as one of his reasons for this action constant interference in the engineering work by Mr. John McDonald, Mayor of Austin, and President of the Board of Public Works. Mr. Groves' resignation has been mentioned because it served to bring out some very decided statements regarding the interference of Mr. McDonald

with the prosecution of the work, and because it seems to substantiate claims to the effect that he and other members of the Board of Public Works really initiated controversies which afterwards caused so much trouble among various engineers. In our issue of June 29, 1893, in an account of the failure of the dam published in one of the Austin papers, there appeared what purported to be official communications from the secretary of the Board of Public Works to Mr. Jas. Waterson, the contractor for the power house, and to Mr. N. Werenskold, engineer, instructing both 'to follow instructions of the Mayor with reference to excavation and the building of the power house, foundation, abutment wall, and other work.'"

Sewage Disposal Legislation.

WITH increase of density of population, the need for sound and effective action in the matter of water supply and sewage disposal forces itself upon the community with so rapid a rise of pressure that it is surprising only that the pressure was so long in being converted into motion. Most European countries long since reached the point where it became necessary in the public interest to put these matters under definite and consistent regulation. The United States are apparently beginning to see the same conditions, but as yet matters are in a most unsatisfactory condition, and it would appear, from the paper lately read by Mr. George Janin before the Canadian Society of Civil Engineers, that affairs in the Dominion are also much in need of improvements.

The rapidly growing population over almost all collecting areas, the upspringing of manufacturing towns in series along formerly unpolluted rivers, and, perhaps more than all, the advance of bacteriological and sanitary science, dispelling many illusions as to self-purification of streams—all these have joined to fasten attention upon two prime necessities: the purification of sewage and manufacturing wastes, or their direction elsewhere than into rivers or other fresh waters; and the purification of public water supplies by some means efficient in reaching not only suspended or dissolved impurities, but bacterial forms. And in this, by the way, slow sand filtration has proved most efficient, as witnessed by results at many plants—notably the large one at Albany lately reviewed in these pages (January and May, 1900).

The two processes obviously bear totally different relations to the interests of the public—the latter affecting only the community directly concerned, while the former (or, rather, the neglect of the former) involves the rights of every riparian owner, individual or corporate, below the point of possible pollution. Yet it seems, unfortunately, as if in most of the States of the Union the use of a stream as a sewer had been almost as free as its utilization for water supply. Courts, in more than one instance, have taken the position to which *The Engineering Record* refers in discussing a recent leading case in New Jersey—they will not "grant an injunction preventing the discharge of sewage into the river to the injury of the owners, but will merely allow them damages for the effects of the pollution. In the words of the court: 'They may obtain redress by amending their bill, or by filing a new bill praying for an injunction unless the city of Paterson' (the defendant corporation in this case) 'will consent to make such compensation to them as shall be ascertained to be just; or they may, if they elect, sue at law for their damages.'" A similar ruling, we believe, was made in Ohio some years ago, though, as the *Record* points out, a Connecticut court in a recent case enjoined the polluters, and Massachusetts has for some time occupied an enlightened position with regard to prevention of river pollution.

The folly and injurious inconsistency of legislative action in connection with these two vitally related matters is strikingly shown in the New Jersey case just referred to. The State legislature, as the *Record* shows, nearly fifty years ago gave to Jersey City (a party to the complaint in the action cited) permission "to draw from the Passaic River a supply of pure and wholesome water." But at subsequent dates the same body gave to Paterson and Newark permission to build sewage systems discharging into the same river above Jersey City. "The permission to obtain a supply of 'pure and wholesome water' from the river merely gave the city the right to get it if it was there; it did not guarantee that the State

would use its authority to keep the river free from pollution."

It is highly interesting, therefore, to note that an apparently direct outcome of this case has been the immediate passage by the New Jersey legislature "of an act increasing very largely the field of the State Sewerage Commission, which is now, in some respects, clothed with powers probably approaching more nearly those of foreign river-pollution commissions than any other body in the United States.

"The Commission has five members appointed by the governor and serving three years. They are paid a salary of $1,500 each, and are allowed to have a secretary, employ assistants and retain experts as occasion warrants. The Legislature keeps a tight rein on the Commission by means of its power to withhold appropriations, for the new act states that the Commission 'may expend such sums of money as shall be duly appropriated.' Those who are familiar with State legislation do not need to be told that such a clause is heavily laden with meaning. A previous organization in the same State for the same purpose was wrecked by a somewhat similar provision for meeting its expenses.

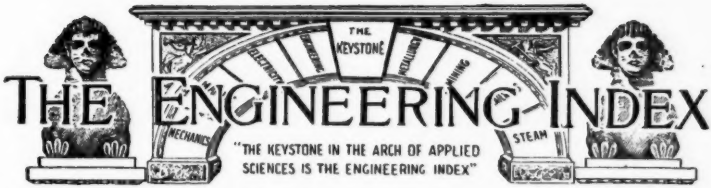
"Fortunately for the welfare of the people, the Commission will be little hampered by the financial obligations it must meet, for the expense attendant on the work must be almost wholly met by the local authorities. The Commission's duties are to study the various methods of sewage disposal and investigate all complaints of the pollution of the waters of the State which may be brought to its notice; if pollution injurious to the health, comfort or property of any inhabitants of the State is found, the Commission must notify the person or corporation causing it, to cease the nuisance and dispose of the sewage in some manner approved by the Commission. The pollution must cease at a time fixed by the Commission, not later than five years from the date of the notice.

"No sewerage system and no sewage treatment works discharging into the waters of the State may be built hereafter until the plans have been approved by the Commission, although existing works are to be allowed to remain in service until the Commission has notified the authorities that changes must be made, as described in the last paragraph. Violations of the provisions of the act may be stopped by writs of injunction issued by the court of chancery on the application of the Commission, after a summary hearing.

"To place the design and construction of sewerage systems and sewage disposal works on the shoulders of any State commission would be foolish, so a provision for the formation of sewerage districts has been made. These are quasi-municipalities, much like the Sanitary Drainage District of Illinois. Their purpose is to organize all the localities which should have a single system of sewerage or sewage disposal works into a political body entirely distinct from the present municipal and township corporations. * * * The interesting feature of their work is the fact that it must all be done subject to the approval of the State Commission. Construction, maintenance and operation are all under the control of the latter body."

Of course, legislation in the United States must be considered tenative until it has been tested in the courts. The *Record* concludes: "If the Legislature chooses to delegate its rights to permit and check the pollution of streams to a Commission reporting annually to itself, it apparently has the power. The trouble will arise, if it does occur, when the Commission attempts to compel some municipality to change its present system of disposal. The courts must then decide whether there is any law and equity by which to force a municipality to reconstruct its sewerage system so as to discharge into some other place than the existing outlet, when the latter has been used heretofore with the consent of the Legislature."

The outcome will be watched with the greatest interest. It is hardly credible that the courts will finally decide otherwise than in a spirit of reason, guided by engineering and sanitary science, and in recognition that liberty to the individual is the measure of freedom remaining when the rights of the remainder of the community have been protected from invasion. And that the discharge of untreated sewage or similar pollution into a stream is, in general, an invasion of public rights can no longer be for a moment disputed.



The object of this Index is to supply all persons interested in engineering and industrial pursuits with, first, an expert descriptive summary clearly indicating the character and purpose of the leading articles published currently in the established technical journals of the United States, Great Britain, and the Continent—in all languages; and, secondly, an inexpensive means of readily obtaining any portions of this literature that may be desired by our readers.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *qr*, a quarterly, *s-q* semi-quarterly, etc. Other abbreviations used in the Index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* Boston, U. S. A.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, U. S. A.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
Annales des Pontes et Chaussées. *m.* Paris.
Architect. *w.* London.
Architectural Record. *q.* New York.
Architectural Review. *s-q.* Boston, U. S. A.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston, U. S. A.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
California Architect. *m.* San Francisco, U. S. A
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.

Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Eclairage Electrique. *w.* Paris.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Detroit.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating. *m.* New York.
Horseless Age. *m.* New York.
Ice and Refrigeration. *m.* New York.
Indian and Eastern Engineer. *m.* Calcutta.
Industries and Iron. *w.* London.
Inland Architect. *m.* Chicago.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Journal Assn. Eng. Socities. *m.* Philadelphia, U. S. A.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Journal Western Soc. of Eng. *b-m.* Chicago,
Journal of Worcester Poly. Inst., Worcester, Mass.
L'Energie Electrique. *w.* Paris.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Marine Engineer. *m.* London.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Master Steam Fitter. *m.* Chicago.
Mechanical Engineer. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco, U. S. A.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl. Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Moniteur des Architects. *m.* Paris.
Moniteur Industriel. *w.* Paris.
Municipal Engineering. *m.* Indianapolis, U. S. A.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nature. *w.* Paris.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
Oest. Monatsschr. f. d. Oeff. Baudienst. *m.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineers' Club. *qr.* Philadelphia, U. S. A.
Progressive Age. *s-m.* New York.
Railroad Car Journal. *m.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U. S. A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie *s-m.* Halle a. S.
Zeitschrift für Elektrotechnik. *s-m.* Halle a. S.

ARCHITECTURAL ENGINEERING

CONSTRUCTION.

Apartment Houses.

The New Houses of J. Kalb, on Friedrichstrasse, Munich (Die Neubauten J. Kalb, Friedrichstrasse 9 u. 11 in München). Illustrated description of a fine block of buildings in harmony with its surroundings. 400 w. Deutsche Bauzeitung—March 17, 1900. No. 33500 B.

Arch.

A Great Arch, Cathedral of St. John the Divine. Illustrated description of the design and execution of a great masonry arch on the top of piers 86 ft. high. The span is 114 ft. out to out of vousoirs. 1800 w. Eng Rec—March 31, 1900. No. 33321.

Chimneys.

Chimney Height and Area. Review of a paper by H. C. Brinckerhoff before the N. E. Cotton Mfrs. Assn., describing the procedure for designing a chimney for a given purpose. 1000 w. Eng Rec—April 28, 1900. No. 33881.

Collapse of a 200-Ft. Brick Chimney. Illustrated description of a stack which failed before it was put in use. 600 w. Eng Rec—April 28, 1900. No. 33882.

The Ornamental Chimneys at the Paris Exposition (Die Zierschornsteine der Weltausstellung in Paris 1900). G. Lang. An illustrated account of the two tall ornamental chimneys for the power plant. 2000 w. Zeitschr d Ver Deutscher Ing—April 7, 1900. No. 33563 D.

Depot Shelter.

The Lyons Depot Shelter, Paris. Illustrated description of a very large shed built over the site of a railway station head-house which was constructed within its shelter. 500 w. Eng Rec—April 21, 1900. No. 33740.

Dome.

Dome Framing, Appellate Court House, New York. Illustrated description of a cylinder framework carrying an upper and a lower dome, supported by brackets from girders of two stories. 500 w. Eng Rec—April 14, 1900. No. 33660.

Fireproofing.

The Horne Fire, Pittsburg. Illustrated description of the results of a fire in a six-story department store, where the contents were almost wholly destroyed without material injury to the steelwork, owing to the protection afforded by fireproofing. 2500 w. Eng Rec—April 14, 1900. No. 33656.

The Second Fire in the Fireproof Horne Store Building, Pittsburg, Pa. Information concerning this fire, with illustrated description of the damage. 1000 w. Eng News—April 26, 1900. No. 33820.

Floors.

Concrete Floors. Frank Caws. Read before the Northern Archt. Assn., at Newcastle. Describes work from the writers' experience, and urging the fireproof construction for all buildings. Ill. 8200 w. Jour Roy Inst of Brit Archts—March 10, 1900. No. 33499 A.

Foundations.

Floating Foundations for Mexico City. J. A. Waddle. Describes a plan to make a solid framework by metal and concrete which shall resist injury from unequal settlement and damage by earthquakes. 900 w. Am Mfr & Ir Wld—April 19, 1900. No. 33763.

Hotel.

Plans for Altering the Inn "zum Weissen Hirschen" in Rothenburg, Bavaria (Entwürfe zur Umgestaltung des Gasthofes zum Weissen Hirschen in Rothenburg O. T.). Illustrated description of plans for bringing this inn into harmony with its mediæval surroundings. 400 w. Deutsche Bauzeitung—March 28, 1900. No. 33501 B.

Japanese Building.

A Japanese Imperial Palace. Illustrated description of the details of the palace of the Crown Prince, the highest building in the country, noteworthy for the elaborate details of the steel-work to prevent distortion by earthquakes. 2000 w. Eng Rec—April 7, 1900. No. 33423.

Materials.

Materials of Construction for Farm and County Buildings (Bedeutung und Enewickelung des Landwirthschaftlichen Bauwesens). Prof. August Prokop. Various tables containing a large number of data concerning materials ordinarily met with in country districts in Austria. Serial. Part 1. 600 w. Weiner Bauind Zeit—April 5, 1900. No. 33547 D.

Paris Exposition.

The Monumental Entrance at the Place de la Concorde (L'Entrée Monumentale de la Place de la Concorde). G. Leugny. An illustrated account, with details of construction, of the main entrance to the Exposition. 2400 w. Revue Technique—March 25, 1900. No. 33599 D.

Prison.

The New Prison Buildings of the Department of the Seine (Les Nouvelles Prisons du Département de la Seine). P. Basquin. A well illustrated description of new penal buildings constructed on modern principles. Serial. Part 1. 7000 w. 1 plate. Génie Civil—March 17, 1900. No. 33589 D.

Reconstruction.

The Reconstruction of the Grand Central Station, New York. Illustrated description of the methods adopted to put in the foundations of heavy walls across tracks in almost constant use. 1400 w. Eng Rec—April 28, 1900. No. 33880.

Roof Trusses.

How to Determine the Stresses in Unsymmetrical Roof Trusses, or in Trusses Unsymmetrically Loaded. F. E. Kidder. An illustrated article showing how to draw the stress diagram. 2000 w. Arch & Build's Mag—April, 1900. Serial. 1st part. No. 33401.

HEATING AND VENTILATION.

Forced Circulation.

Mechanical Ventilation and Heating. Illustrated abstract of lecture by Walter B. Snow on the financial advantages of mechanical draft and ventilation. 2200 w. Eng Rec—April 21, 1900. No. 33739.

House Heating.

Fuel Necessary to Heat Small Buildings (Combustile Nécessaire pour le Chauffage d'un Local). Short article by J. Orpiszewski in the *Revue technique de Varsovie*, abstracted in the *Bulletin de la Société Vaudoise des Ingenieurs et des Architects*, showing how to determine the amount of fuel necessary to keep a room at a given temperature. 400 w. Moniteur Industriel—March 31, 1900. No. 33596 E.

Large Buildings.

Ventilation of Large Buildings. Merwyn O'Gorman. Read before the Civ. and Mech. Engs.' Soc. of London. Discusses methods used and the importance of furnishing 1000 cubic feet of air per hour for each person. 4400 w. Arch't, Lond—March 23, 1900. No. 33377 A.

Ventilation and Heating of the Methodist Episcopal Home for the Aged, Philadelphia. Illustrated description of a plenum system in a building having an unusual amount of exterior wall surface in proportion to its floor area, and a more exposed location than structures usually heated in this way. 2500 w. Eng Rec—April 28, 1900. No. 33884.

Steam Heating.

The Distribution of Steam at Dartmouth College. Illustrated description of the system employed in heating 16 detached buildings from a central station, with details of the special features of the expansion joints and devices. Also gives results of a boiler test. 2500 w. Eng Rec—March 31, 1900. No. 33327.

PLUMBING AND GAS FITTING.

Hot Water.

The Heating of Water (Warmwasserbereitung). M. Grellert. An illustrated account of a system of heating water for various purposes in a house by means of the kitchen fire, with calculations of the efficiency of the system. Two articles, 3600 w. Gesundheits Ing—March 15, 31, 1900. No. 33519 each B.

Office Building.

Plumbing in the Broadway Chambers Building, New York. Illustrated description of work which has no pressure tanks on the roof for the water system, using compressed air receivers instead, and employing closet-flushing apparatus without flush tanks. 1000 w. Eng Rec—April 7, 1900. No. 33424.

MISCELLANY.

Acoustics.

Architectural Acoustics. Wallace C. Sabine. A description of the various causes of defective sound distribution in rooms, and of methods of investigating them, both quantitatively and qualitatively. 3900 w. Eng Rec—April 14, 1900. No. 33659.

Architectural Acoustics — Reverberation, Absorbing Power of Wall Surface. Wallace C. Sabine. Illustrated description of the methods of determining the reverberation and absorbing power of rooms in terms of open windows as units of measurement. 3500 w. Eng Rec—April 21, 1900. No. 33738.

Architectural Acoustics—Reverberation, Approximate Solution. Wallace C. Sabine. Explanation of a method of providing for the absorption of reverberation in halls as soon as their shape has been learned. Ill. 1800 w. Eng Rec—April 28, 1900. No. 33883.

Laboratory.

The Carnegie Laboratory of Engineering. Illustrated description. 1500 w. Stevens Ind—April, 1900. No. 33837 D.

New Patent Office.

The Need of a New Building for the United States Patent Office. George L. Morton. Reviews the history of this department, and shows the urgent need of a new fire-proof building. 3500 w. R R Gaz—April 13, 1900. No. 33648.

Paris Exposition.

The Paris International Exhibition. A critical review of the exhibition at the opening, with plans. 6500 w. Engng—April 20, 1900. No. 33942 A.

CIVIL ENGINEERING

BRIDGES.

Arcade Girder.

The Vierendeel Arcade Girder (Pont à Arcades, Système Vierendeel). A. Morizot. A long illustrated description, with the theory of the truss. Serial. Part I. 2000 w. Revue Technique—March 10, 1900. No. 33597 D.

Construction.

Special Bridge and Viaduct Construction in Western Pennsylvania. Illustrated description of the details and construction of 22,000 tons of viaducts and bridges on the Carnegie railways. Part first describes mainly the viaducts, including one which carries two tracks at different elevations. 1500 w. Eng Rec—April 28, 1900. Serial. 1st part. No. 33878.

East River Bridge.

Mason Work on the New East River Bridge Anchorages. Illustrated description of the design, and contractors' methods. 1900 w. Eng Rec—April 7, 1900. No. 33418.

Lift Bridge.

An Electrically-Operated Bridge. Describes the method of operating a lift bridge of 34 ft. span and 66 ft. width. 500 w. Eng Rec—April 7, 1900. No. 33422.

Memorial Bridge.

The Memorial Bridge Across the Potomac. Illustrated description of the design submitted in the limited competition for a bridge of about 3,500 ft. length, between Washington and Arlington, as a monument to American patriotism. The prize design employs concrete steel construction very largely. All designs were prepared by engineers and architects working together. Also an editorial on the importance of the competition. 11200 w. Eng Rec—April 21, 1900. No. 33733.

Rapid Construction.

Hopetown Bridge. Brief account, with illustrations, of the rebuilding of the channel span of the road bridge over the Orange River, in Cape Colony, in 18 days after the receipt of the order. 500 w. Engng—March 23, 1900. No. 33390 A.

Repairing.

Repairing a Fractured Stone-Arch Bridge, P. and R. Ry. Illustrates and describes an interesting and somewhat unusual piece of masonry work. 1300 w. Ry & Engng Rev—March 31, 1900. No. 33360.

Stresses.

The Position of Wheel Loads Causing Maximum Stresses in Web Members. M. A. Howe. Considers only simple trusses which have one set of web members vertical. Ill. 1200 w. R R Gaz—April 20, 1900. No. 33758.

Train Loads.

American Train Loads in the Calculation of Bridges (Ueber Amerikanische Belastungszüge für die Berechnung von Brücken). F. C. Kunz. An article with a table and diagrams comparing the bridge loads on various American and foreign railways. 1000 w. 1 plate. Oesterr Monatschr f d Oeffent Baudienst—April, 1900. No. 33530 G.

CONSTRUCTION.

Columns.

The Practical Column Under Central or Eccentric Loads. J. M. Moncrieff. Deduction of new formulæ and development of a theory of column resistance. Diagrams. 25000 w. Pro Am Soc of Civ Engs—March, 1900. No. 33307 E.

Foundations.

Notes on Foundations (Einiges über Fundamente). Adolf Francke. Particularly on the proper distribution of pressure. Formulæ, with diagrams and examples. 600 w. Schweiz Bauzeitung—April 7, 1900. No. 33540 B.

Frameworks.

The Exact Design of Statically Indeterminate Frameworks. An Exposition of Its Possibility, but Futility. Discussion of paper by Frank H. Cilley. 16300 w. Pro Am Soc of Civ Engs—April, 1900. No. 33806 E.

Hennebique System.

The Hennebique System (Das System Hennebique). Ed. Ast. An illustrated description of Francois Hennebique's system of construction with structural steel and iron imbedded in concrete, with its application in a variety of cases. 3500 w. Zeitschr d Oesterr Ing u Arch Ver—March 30, 1900. No. 33550 B.

Metal Protection.

Experiments on the Protection of Steel and Aluminum Exposed to Water. Continued discussion of paper by A. H. Sabin on this subject. 1300 w. Pro Am Soc of Civ Engs—April, 1900. No. 33803 E.

Roads.

Notes on Road Construction and Maintenance. A statement of experience gained during 1899 on the Massachusetts

State roads, together with a brief description of the methods of constructing roads for traffic of different sorts in Great Britain. 1500 w. Eng Rec—April 21, 1900. No. 33734.

Sewers.

Formulas for Computing Quantities of Brickwork in Egg-Shaped Sewers. Philip P. Farley. Formulas given were developed for the writer's own use. 400 w. Eng News—April 19, 1900. No. 33727.

Tunnel.

Building the Ronco Tunnel, Near Genoa, Italy. From *Le Génie Civil.* Briefly describes the method of reconstruction, giving illustrations. 800 w. Eng News—April 19, 1900. No. 33725.

New York and the Rapid-Transit Tunnel—What Streams and Creeks It Cuts Through. A short description of the creeks underlying Manhattan island which must be diverted or arched over. 1400 w. Fire & Water—April 7, 1900. No. 33443.

The Blackwall Tunnel, London. Illustrations and brief description of the construction, of interest in connection with the project for connecting Brooklyn and Manhattan by tunnel. 1800 w. Sci Am—April 7, 1900. No. 33410.

HYDRAULIC AND WATER SUPPLY.

Canals.

See also "Panama" and "Nicaragua."

The Trans-Isthmian Canal. Henderson Gilbert. A review of the various projects for the construction of such a canal, and the present outlook. 1800 w. Yale Sci M—April, 1900. No. 33606 C.

The Ship Canal Across the American Isthmus. A review of the engineering difficulties not considered in the report of the Walker commission which investigated the Nicaragua route. 1300 w. Eng Rec—April 28, 1900. Serial. 1st part. No. 33876.

The Rhine-Elbe Canal—A Feature in German Politics. James Howard Gore. An explanation of the importance of this project. 1800 w. Rev of Revs—April, 1900. No. 33351 C.

Conduits.

New Gaugings of the Rochester Conduits. Describes the results of measurements on the old and new Hemlock conduits in 1898, indicating a slight reduction in their carrying capacity. 1500 w. Eng Rec—April 7, 1900. No. 33419.

Dam.

The Foundations of the New Croton Dam. Discussion of paper by Charles S. Gowen. 7500 w. Pro Am Soc of Civ Engs—April, 1900. No. 33804 E.

The Reconstructed Canyon Ferry Dam, Near Helena, Mont. Illustrated description of the original dam and its reconstruction, with comments. 1000 w. Eng News—April 26, 1900. No. 33819.

Dam Failure.

Failure of the Great Masonry Dam Across the Colorado River at Austin, Tex. Illustrated description of the break which occurred on April 7, with an outline of preceding troubles, and review of the work. 2000 w. Eng News—April 12, 1900. No. 33644.

The Failure of the Austin Dam. Illustrated description of the construction of this masonry dam, 1,275 feet long and 68 feet high, of the overflow type, which was wrecked by a flood. 2200 w. Eng Rec—April 14, 1900. No. 33655.

The Failure of the Austin Dam. Reports of the failure from T. U. Taylor, H. M. Chance, and A. B. Roome, with illustrations. 6000 w. Eng News—April 19, 1900. No. 33724.

Failure of the Austin Dam. R. D. Parker. Illustrated description of the failure of a 68-foot masonry dam, written by an engineer who was at the scene soon after the accident, and personally interviewed reliable witnesses of the break. 1000 w. Eng Rec—April 21, 1900. No. 33737.

The Failure of the Masonry Dam at Austin, Tex. Brief illustrated description, with remarks on the probable cause of the disaster. 1000 w. Sci Am—April 28, 1900. No. 33829.

Erie Canal.

The Improvement of a Portion of the Jordan Level of the Erie Canal. Continued discussion of paper by William B. Landreth on this subject. 4500 w. Pro Am Soc of Civ Engs—April, 1900. No. 33805 E.

Filtration.

The Albany Water Filtration Plant. Continued discussion of paper by Allen Hazen. 8000 w. Pro Am Soc of Civ Engs—April, 1900. No. 33808 E.

Iron Removal from Ground Water at Far Rockaway by Slow Sand Filtration. Illustrates and describes the apparently efficient plant of the Queens County Water Company. 1200 w. Eng News—April 12, 1900. No. 33643.

Slow Filtration at Albany. A discussion of the results of the operation of the covered sand filters, by G. I. Bailey, G. C. Whipple, and G. W. Fuller. 3000 w. Eng Rec—April 7, 1900. No. 33420.

Slow Sand Filtration, Nyack, N. Y. Illustrated description of the details of a pair of open filter beds, with a combined area of 1-3 acre. 800 w. Eng Rec—April 28, 1900. No. 33879.

Floating Dock.

700-Foot Floating Dock at South Brooklyn. Illustrated description of this

large pontoon dry-dock which is under construction, and of the method of docking a ship. 1400 w. Sci Am—April 21, 1900. No. 33716.

Floods.

Work Done for the Controlling of Irregular Streams in Austria (Die Bisherige Thätigkeit auf dem Gebiete der Wildbachverbauung in Niederösterreich). An account of the work already done to prevent disastrous overflows from brooks and small streams in Lower and Upper Austria, with tables. 3300 w. Oesterr Monatschr f d Oeffent Baudienst—April, 1900. No. 33532 G.

The Prevention of the Flooding of the Embankment of the Austrian North-Western Railroad (Uber die im Vorjahre von der Oesterr. Nordwestbahn getroffenen Massnahmen gegen eine Ueberflutheung des Bahndammes zwischen Bisamberg und Stockerau). A. Walzel. An illustrated account of the precautions taken and the effective work done at the time of the floods in the fall of 1899. 4500 w. Zeitschr d Oest Ing u Arch Ver—March 16, 1900. No. 33548 B.

Flow.

Experiments in the Flow of Water in the Six-Foot Steel and Wood Pipe Line of the Pioneer Electric-Power Company, at Ogden, Utah. Second series. Discussion of paper by Charles D. Marx, Charles B. Wing, and Leander M. Hoskins. 12500 w. Pro Am Soc of Civ Engs—April, 1900. No. 33807 E.

On the Flow of Water Over Dams. George W. Rafter. Presents a collection of new facts obtained during investigations as to the water supply for summit-level canals in the State of New York. Gives points from Bazin's papers, and experimental data from Cornell Univ. and other sources, showing the erroneous use of sharp-crested weir formulas for computing the flow over weirs of all shapes. Ill. 18600 w. Pro Am Soc of Civ Engs—March, 1900. No. 33306 E.

Locks.

The Dutton Pneumatic Balance Locks for Canals. Chauncey N. Dutton. Illustrated description of the characteristic features of these locks, and their operation. 8500 w. Jour Fr Inst—April, 1900. No. 33341 D.

Metal Protection.

See Civil Engineering, Construction.

Niagara.

Discharge Measurement of the Niagara River at Buffalo, N. Y. Discussion of paper by Clinton B. Stewart. 7000 w. Jour W Soc of Engs—Feb., 1900. No. 33340 D.

Nicaragua.

An Assumed Inconstancy in the Level of Lake Nicaragua; a Question of Permanency of the Nicaragua Canal. C. Willard Hayes. Undertakes to answer the questions raised in a recent paper by Angelo Heilprin, and claims the region is favorable for the proposed canal. 2200 w. Nat Geog Mag—April, 1900. No. 33473 C.

Panama Canal.

The Panama Canal (Le Canal de Panama). A. Dumas. A historical sketch, with a general discussion of the plans of the new company. Serial. Part I. 5000 w. Génie Civil—April 7, 1900. No. 33-593 D.

Pollution.

The Prevention of Water Pollution in New Jersey. Editorial discussion of recent legislation in New Jersey. 3000 w. Eng News—April 5, 1900. No. 33451.

Pollution of Streams, with Special Reference to the Chicago Drainage Channel. B. H. Colby. Discusses the contamination of streams and the serious results, especially considering what should be done in St. Louis. Refers to the danger from the Chicago drainage channel, and urges filtration. 4200 w. Jour Assn of Engng Socs—Feb., 1900. No. 33337 C.

Power Development.

Construction of the Shawinigan Water and Power Company's Plant. Illustrated description of the hydraulic works to develop 60,000 horse-power at Shawinigan Falls. The coffer dam details were unusual on account of the great current at the site. 5000 w. Eng Rec—April 28, 1900. No. 33877.

The Niagara Falls Hydraulic Power and Manufacturing Company. A. Scheufelen. A well illustrated description of the canal and the power-house below the falls, with remarks on the industries to which the power is applied. 2500 w. 1 plate. Zeitschr d Ver Deutscher Ing—March 17, 1900. No. 33554 D.

Pressure.

Plant for Increasing the Pressure at Ostrawa, Moravia (Druckerhöhungsanlagen in Mähr-Ostrau). K. Czerwenka. Illustrated description of an economical method of increasing the pressure by one atmosphere at a small water-works. 800 w. 1 plate. Oesterr Monatschr f d Oeffent Baudienst—April, 1900. No. 33-529 G.

Protective Device.

New Method of Diminishing the Force of Waves and Surf. An invention consisting of a floating net, retained on the surface of the water by outriggers, or by buoys. Ill. 1100 w. U. S. Cons Repts, No. 705—April 16, 1900. No. 33446 D.

Pumping Plant.

The Auxiliary Hydraulic Pumping

Plant of the Peoria Water-Works Co., Peoria, Ill. Dabney H. Maury, Jr. Illustrated detailed description of the plant, with account of the tests and operation. 4000 w. Eng News—April 26, 1900. No. 33821.

Riparian Rights.

An Important Decision Upon a Mill Owner's Suit to Collect Damages for Diversion of Water. Letter from Louis L. Tribus concerning the Newton case, with Judge Dixon's opinion. 2200 w. Eng News—April 5, 1900. No. 33452.

Rivers.

River Hydraulics. Continued discussion of paper by James A. Seddon. 3000 w. Pro Am Soc of Civ Engs—March, 1899. No. 33308 E.

Springs.

The Development of Springs at Fayetteville, Tenn. Describes the methods adopted in developing a number of sand-rock springs for the supply of a town of 3000 people. 1000 w. Eng Rec—April 21, 1900. No. 33741.

Water Supply.

Mr. J. R. Freeman's report on the New York Water Supply. Illustrated review of a report showing that there were serious errors in the assumed discharge of the old and new Croton aqueducts and in the run-off of the Croton River watershed; the records of the latter have previously been accepted as correct and ranked among the most important water-works data. Also expresses doubt as to any early reduction in water waste. 1800 w. Eng Rec—April 14, 1900. Serial. 1st part. No. 33654.

The Water Waste and Water Supply of New York City. Review of the report of John R. Freeman, with editorial notes. 8500 w. Eng News—April 19, 1900. No. 33728.

Water-Works.

New Water-Works, Latrobe, Pa. Illustrated description of a pumping plant with unusually complete piping for a small station, a reservoir, with concrete and brick lining, and a by-pass for pumping around and much higher than the reservoir to obtain extra head in case of fire. 1200 w. Eng Rec—March 31, 1900. No. 33323.

Progress on the New Water-Works for Cincinnati, O. Illustrated account of interesting work now in progress to pump water from the Ohio River to settling basins. 1300 w. Eng News—April 26, 1900. No. 33822.

The Disaster to the Water-Power Plant at Hannawa Falls, N. Y. Brief description of the works and the damage caused, with illustrations. 1200 w. Eng News—April 26, 1900. No. 33826.

MATERIALS.

See also Architectural Engineering, Construction.

Brick Testing.

A Method of Comparing Rattler Tests of Paving Brick. Daniel B. Luten. Illustrates and describes several rattlers, and discusses the value of the test. Also explains method of comparing. 2800 w. Munic Engng—April, 1900. No. 33345 C.

Paving Brick Tests. W. K. Hatt. Letter, with diagram, on the influence of moisture on the results of brick tests by the rattler method. 500 w. Eng Rec—April 7, 1900. No. 33426.

Building Stones.

Building Stones and Stone Cutting. Alexander Marshall. Read before the Toronto Chapter, Ontario Assn. of Archts. Suggestions concerning the choice of building stone, and the kinds most used, with remarks on stone-cutting. 2200 w. Stone—April, 1900. No. 33639 C.

Cement.

New Works of the William Krause & Sons Cement Company. Horace DeK. Haight. Illustrates and describes a plant of 600 bbls. capacity, in which the power-transmission apparatus received particular attention. 2500 w. Eng Rec—March 31, 1900. No. 33326.

Progress Report of the Special Committee on the Proper Manipulation of Tests of Cement. 21500 w. Pro Am Soc of Civ Engs—April, 1900. No. 33802 E.

Refractory Linings for Rotary Portland-Cement Kilns. Edward Duryea. Explains the making of linings lasting much longer than those of the usual composition. 1000 w. Eng Rec—March 31, 1900. No. 33325.

Concrete.

Armored Concrete. A résumé of results obtained in recent trials of this material, with discussion of the conclusions reached. 1900 w. Engr, Lond—March 30, 1900. No. 33617 A.

Corrosion.

Paints and Varnishes. A. H. Sabin. Considers methods for the protection of iron, describing briefly the pigments used for preservative paints. 5500 w. Jour Assn of Engng Socs—Feb., 1900. No. 33-338 C.

See also Metal Protection, under Civil Engineering, Construction.

Mortar.

Mortar. Gustave W. Drach. Read at meeting of the Cincinnati Chapter of Architects. The history of the use of this material is given and the various kinds of mortars discussed. 2500 w. Stone—April, 1900. No. 33638 C.

Shale.

The Origin, Properties, and Uses of Shale. H. Ries. Discusses principally the properties. 2000 w. Stone—April, 1900. No. 33640 C.

Shock Elasticity.

An Example of Elasticity and Tenacity Under Sudden Blows (Eine Aufgabe aus der Stosselastizität und-festigkeit). F. Leitzmann. A mathematical discussion of the shock elasticity of steel, based on the bending of wheel axles in railroad practice. Serial. Part I. 1800 w. Zeitschr d Ver Deutscher Ing—March 31, 1900. No. 33560 D.

Testing Laboratory.

Report on the Work of the Royal Technical Testing Laboratory, Berlin, for the Year 1898-99 (Bericht über die Thätigkeit der Königlichen Technischen Versuchsanstalten im Etatsjahre, 1898-99). Record of the tests conducted at this institution, of metals, building materials, paper, oils, and list of chemical analyses. 5200 w. Mitt aus d Kgl Tech Versuchsanst—No. 6, 1899. No. 33526 G.

MUNICIPAL.

See also Civil Engineering, Construction.

Auxiliary Pipes.

Auxiliary Pipe Systems for Extinguishing Fires. Editorial on the inadequacy for fire-extinguishing purposes of the pressure in the small pipe systems. Suggested by the recent fire at Greenpoint, N. Y. 700 w. Eng News—April 19, 1900. No. 33726.

Cleaning.

Municipal Cleansing in Great Britain. Reviews interesting details of English practice as set forth in a recent report of the Assn. of Cleansing Supts. of Gt. Britain. 2600 w. Eng News—April 26, 1900. No. 33824.

Garbage.

Garbage Cremation in New York. Shows that the discontinuance of cremation was due to local conditions of haul and not to failure of destructors. 500 w. Eng Rec—March 31, 1900. No. 33320.

Notes on Garbage Disposal at Cincinnati, Ohio. Brief account of the system employed. 1200 w. Eng News—April 26, 1900. No. 33823.

Pavements.

Smoothness of Pavements. Daniel B. Luten. Illustrated description of examinations made of various kinds of pavements in Lafayette, Ind. 3000 w. Eng Rec—March 31, 1900. No. 33322.

See also Sidewalks.

Sewage.

English Experiments on the Bacterial Treatment of Sewage, with an Account of the Work Done at Manchester, England, During the Past Year. Leonard P. Kinnicutt. Reviews briefly the experimental study of this subject, giving the history of sewage treatment at Manchester, where what is known as the double contact system has been carefully studied. Ill. 13000 w. Jour Assn of Engng Socs—Feb., 1900. No. 33336 C.

Purification of Sewage by Means of the Soil. George Janin. Discusses the experiments and conclusions regarding the purification by the soil and agricultural utilization of sewage, the operation and rules, giving report of the sewage farm of St. Laurent College. Ill. 5400 w. Can Soc of Civ Engs—Adv. Brief—April 12, 1900. No. 33761 D.

Sewage Disposal by Intermittent Filtration at Leicester, Mass. Information concerning this plant, which seems to be giving satisfaction, and of the character of the sewage. 1400 w. Eng News—April 5, 1900. No. 33455.

The Bacteriological Treatment of Sewage. H. T. Scoble. Read at meeting of the Surveyor's Inst., London. Reviews and discusses the various processes now in use. General discussion. 1400 w. San—April, 1900. No. 33369 D.

The International System of Bacterial Sewage Treatment. Explains works at Southwold and Reigate, England, in which sewage is distributed by revolving arms over filters containing polarite. At Southwold there is also a preliminary filtration through anaerobic beds. 1800 w. Eng Rec—April 7, 1900. No. 33421.

The Filtering Beds of Brandenburg, Prussia (Die Rieselfeldanlage der Stadt Brandenburg a. H.). E. Bernhard. A brief description of the large field of over 250 acres to which the sewage from Brandenburg is led for filtration. 400 w. 1 plate. Gesundheits Ing—March 31, 1900. No. 33521 B.

The Sewerage of Ealing, England. James H. Fuertes. Describes a system of treatment involving the use of lime, clay and sulphate of alumina, with the cremation of the sludge. 700 w. Eng Rec—April 21, 1900. No. 33735.

The Worcester Sludge Process. Illustrated description of the largest sewage filter press plant in the United States. 1400 w. Eng Rec—April 21, 1900. No. 33736.

Sewage Disposal in New Jersey. Review of two decisions of the court of final jurisdiction permitting the discharge of sewage into streams, subject only to the payment of damages to riparian owners along the non-tidal portions of the rivers. 900 w. Eng Rec—March 31, 1900. No. 33319.

Sewerage.

The New Jersey State Sewerage Com-

mission. Explains the power of a commission which has been given practically absolute control over the sewerage and sewage disposal systems of New Jersey. 900 w. Eng Rec—April 7, 1900. No. 33416.

Sewer Work at Woonsocket, R. I. Illustrated description of inverted siphons, weir, manholes and tunneling operations. 600 w. Eng Rec—March 31, 1900. No. 33324.

The Sewerage of Frankfort-on-the-Main. J. H. Fuertes. Illustrates and describes details of the sewers, which are particularly well constructed. 1200 w. Eng Rec—April 14, 1900. No. 33658.

The Sewerage Problem of the City of Worcester, Mass. An explanation of the topography of the city and the existing conditions, with an illustrated description of the plant now in operation, on the chemical precipitation system. 1600 w. Sci Am Sup—April 7, 1900. No. 33411.

Sewers.

Cleaning Sewers. Elmer D. Fletcher. A discussion of the merits of various methods. 1300 w. Eng Rec—April 7, 1900. No. 33425.

Sidewalks.

Some Theories Regarding Cement Walks. Daniel B. Luten. Illustrated description of different classes of failure in walks and methods of avoiding them. 3300 w. Eng Rec—April 14, 1900. No. 33657.

See also Pavements.

Water Supply.

See Civil Engineering, Hydraulics and Water Supply.

ELECTRICAL ENGINEERING

COMMUNICATION.

Cables.

A United States Government Pacific Cable. George Owen Squier. Discusses the need, practicability, routes, stations, and various subjects relating to the enterprise, giving plates, maps, etc. 10000 w. Jour U. S. Art—March-April, 1900. No. 33626 D.

The Pacific Cable. Opinions in the Canadian House of Commons. 4500 w. Elec Rev, Lond—March 30, 1900. No. 33614 A.

Multiplex Telegraphy.

A Tele-Microphone Differential Relay in a Multiplex-Telegraphy System (Sur la Télégraphie Multiplex Relai Telemicrophonique Différentiel). E. Mercadier. An illustrated description. 600 w. Comptes Rendus—March 19, 1900. No. 33584 D.

Printing Telegraphs.

Printing Telegraphs (Ueber Ferndrucker). Dr. Raps. An address delivered before the Electrotechnical Society, of Berlin, giving a particular description of the Siemens and Halske apparatus, with a general historical sketch of the subject; with illustrations. 3000 w. Elektrotech Zeitschr—April 12, 1900. No. 33518 B.

Space Telegraphy.

Novelties in Receiving Apparatus in Wireless Telegraphy (Sur l'Emploi de Nouveaux Radio-conducteurs pour la Télégraphie sans Fil). C. Tissot. Filings of magnetic and non-magnetic substances were used in the coherer, which was placed in a magnetic field parallel with the lines of force, with good results as regards reliability. 600 w. Comptes Rendus—April 2, 1900. No. 33585 D.

The Auto-Decohering of Carbon and Its Application in a Telephonic Receiver for Wireless Telegraphy Signals (Sur l'Auto-Decohération du Charbon, et sur l'Application de cette Découverte aux Appareils Téléphoniques pour Recevoir les Signaux de la Télégraphie sans Fils). Thomas Tounnasina. A carbon powder receiver. 600 w. Comptes Rendus—April 2, 1900. No. 33586 D.

See also Coherer under Electro-Physics.

Telegraphs.

A Model Telegraph Plant. G. H. Page. Brief illustrated description of a plant at Oelwein, Ia. 600 w. Elec Rev, N. Y.—April 18, 1900. No. 33744.

Telegraph-Telephone.

Simultaneous Telegraphy and Telephony on One Wire; with Special Reference to the Operation of the Berlin Fire Department (Gleichzeitiges Telegraphiren und Telephoniren ouf einer Leitung, besonders im Betriebe des Berliner Feuerwehr). F. Walloch. An address delivered before the Hanover Electrotechnical Society, describing the system used in the Berlin Fire Department, with illustrations. 2000 w. Elektrotech Zeitschr—March 22, 1900. No. 33508 B.

Telephones.

Ducousso Telephone Switchboards (Tableaux Téléphoniques Ducousso). L. Moutillot. An illustrated description of a switchboard designed to prevent the operator from hearing the conversation.

Also, of another switchboard, without this feature. 1700 w. L'Electricien—March 24, 1900. No. 33587 B.

Toll-Lines.

Design of the L. M. and B. H. System. H. P. Clausen. Illustrated detailed description of this system, discussing the signaling service. 3200 w. Tel Mag—April, 1900. No. 33787.

DISTRIBUTION.

Alternating Currents.

Formulæ for Calculating the Drop in Alternating-Current Conductors (Formeln zur Berechnung des Spannungsabfalls in Wechselstromleitungen). Dr. L. Fleischmann. Formulæ giving the exact determination of the drop. 600 w. Elektrotech Zeitschr—March 29, 1900. No. 33511 B.

The Production of Asymmetrical Alternating Currents by Means of Electrolytic Polarization. W. L. Hildburgh. Deals only with asymmetrical conductors whose action depends on counter e. m. fs. produced by electrolysis. 3500 w. Elec Wld & Engr—April 14, 1900. Serial. 1st part. No. 33666.

Equalizers.

The Calculation of Lighting-Circuit Regulators (Beitrag zur Berechnung von Lichtleitungs-Regulatoren). E. Stadelmann. An article giving formulæ and curves for calculating the resistance for equalizing the pressure in electric lighting circuits. 1600 w. Elektrotech Zeitschr—April 12, 1900. No. 33517 B.

Hunting.

Hunting of Alternating Current Apparatus. H. W. Buck. Explains what the phenomenon of hunting is, the cause, and the laws which govern it, with related matter. Ill. 1800 w. Elec Wld & Engr—April 7, 1900. No. 33494.

Polyphase.

Some Work with Polyphase Apparatus. J. L. Thomas. Illustrates and describes the plant operated by the Consolidated Lighting Co., of Montpelier, Vt., and the satisfactory working of the three-phase apparatus. 1300 w. Elec Wld & Engr—April 14, 1900. No. 33663.

The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City. J. E. Woodbridge. Begins an illustrated description of the power generating equipment of the largest railway power plant in the world. 1400 w. Elec Wld & Engr—March 31, 1900. Serial. 1st part. No. 33354.

A Polyphase Power Plant. Frank C. Perkins. Brief illustrated description of the Montana Power Company's station on Big Hole River. 700 w. Elec Rev, N. Y.—April 18, 1900. No. 33746.

Rotary Currents.

The Wave Form of the Rotary Current (Ueber die Wellenform des Drehstromes). O. S. Bragstad. A mathematical discussion, with an experimental determination of the theory developed. Diagrams and formulæ. 2400 w. Elektrotech Zeitschr—March 29, 1900. No. 33510 B.

Works-Distribution.

Electric-Power Distribution. An illustrated description of the works of the Westinghouse Air Brake Company. 3000 w. Am Engr & R R Jour—April, 1900. No. 33317 C.

ELECTRO-CHEMISTRY.

Accumulators.

New Active Material for Accumulators (Neue Akkumulatoren-Masse). A rather indefinite account of a new active material which it is claimed will obviate the use of plates. 500 w. Elektrochemische Zeitschr—April, 1900. No. 33-503 G.

Cells.

Energy Losses in Galvanic Cells—Their Cause and Prevention. J. Warren. The first of a series of articles aiming to investigate the various causes detracting from the efficient working of the cells. 1500 w. Elec. Lond—April 13, 1900. Serial. 1st part. No. 33768.

Two New Forms of Mercury Cell for the Electrolytic Production of Alkalies and Chlorine. John B. C. Kershaw. Illustrates and describes two new forms in which mechanical movements are dispensed with, and the forces of gravitation effect the removal of the amalgam from the cells. 1500 w. Elec Rev, Lond—April 13, 1900. No. 33798 A.

Chlorates.

The Electrolytic Preparation of Chlorates (Ueber Elektrolytische Chloratdarstellung). John Laudin. Abstract of a paper read before the Swedish Engineers' Society, Stockholm. 1500 w. Zeitschr f Elektrochemie—March 22, 1900. No. 33564 G.

Conductivity.

Investigation of the Conductivity of Dilute Solutions of Double Salts (Verfahren zur Ermittelung des Leitungsvermögens Mässig mit Wasser Verdünnter Doppelsalzlösungen). J. G. MacGregor and J. H. Archibald. An account of experiments, with tables showing the observed and calculated values. 3000 w. Elektrochemische Zeitschr—April, 1900. No. 33504 G.

Electro-Engraving.

Electro-Gravures (Elektrogravüre). Josef Rieder. A long illustrated description of the author's new method of etch-

ing steel. 7000 w. Elektrochemische Zeitschr—April, 1900. No. 33502 G.

Reactions.

The Action of Carbon Upon Refractory Oxides at High Temperatures. Alec. A. Beadle. On some of the reactions that occur when subjecting metals (or non-metals) to reduction with carbon at the high temperatures obtainable in the electric furnace. 2000 w. Elec Rev, Lond—April 13, 1900. No. 33799 A.

Sodium.

On Electrical Effects Due to Evaporation of Sodium in Air and Other Gases. W. Craig Henderson. Communicated to the Royal Soc. An account of experiments to determine whether evaporation of an unelectrified liquid produces any electrification. 800 w. Elect'n, Lond—April 6, 1900. No. 33691 A.

Storage Batteries.

Storage Battery Problems. E. J. Wade. Read before the Inst. of Elec. Engs. A discussion of some of the theoretical and chemical questions connected with the lead cell. Also editorial. 8000 w. Elect'n, Lond—March 23, 1900. Serial. 1st part. No. 33378 A.

ELECTRO-PHYSICS.

Apparatus.

Arrangement for Drawing Off the Gas from Electrolytic Apparatus with Horizontal Electrodes (Gasabzugs-Einrichtung für Elektrolytische Apparate mit Wesentlich Horizontal Angeordneten Elektroden). W. Bein. An illustrated account of apparatus patented in Germany. 600 w. Zeitschr f Elektrochemie—March 29, 1900. No. 33565 G.

Coherer.

Investigations Into the Method of Operation of the Coherer (Untersuchungen über die Wirkungsweise des Fritters). J. Härdén. An examination of coherers under the microscope, to determine how the resistance is lowered. 1000 w. Elektrotech Zeitschr—April 5, 1900. No. 33515 B.

Some New Coherer Phenomena. F. Companile and G. di Ciommo. Abstract translation of article in *L'Elettricita*, describing experiments undertaken to obtain information as to the nature of coherer action. Ill. 900 w. Elec Rev, N. Y.—April 4, 1900. No. 33412.

Electrolytes.

Are Rarefied Gases Electrolytes? M. E. Bouty. Read before the Société Francaise de Physique. Describes investigations of the writer and gives results. 2000 w. Elect'n, Lond—March 23, 1900. No. 33379 A.

Hysteresis.

Hysteresis in Sheet Iron and Steel. Arthur Hillyer Ford. An account of researches on commercial transformers, undertaken with the object of showing the conditions met in practice. Also on small specimens of iron obtained from various makers and users. 1800 w. Trans Am Inst of Elec Engs—March, 1900. No. 33769 D.

Interrupter.

A Working Form of Wehnelt Interrupter. Weston A. Price. Illustrated description. 450 w. Elec Rev, N. Y.—April 11, 1900. No. 33630.

Magnetic Properties.

On the Difference Between Constant and Variable Magnetization (Ueber den Unterschied zwischen Stetiger und Unstetiger Magnetisirung). E. Gumlich and Erich Schmidt. A contribution from the National Laboratory in Berlin, giving the results of experiments, with tables. 1300 w. Elektrotech Zeitschr—March 22, 1900. No. 33505 B.

Magnetic Separation.

The Principle of Electromagnetic Separation (Das Elektromagnetische Aufbereitungsprinzip). E. Langguth. A theoretical discussion. 3300 w. Zeitschr f Elektrochemie—April 5, 1900. No. 33-566 G.

Rontgen Tube.

A New Röntgen Tube with Ernst Pabst's Anti-cathode (Ueber eine Neue Röntgenröhre mit Ernst Pabst's Anti-Kathode). F. Kurlbaum. Showing the advantage of coating the anti-cathode with platinum black, which has high emissive power and so keeps down the temperature. 700 w. Elektrotech Zeitschr—March 22, 1900. No. 33507 B.

Thermo-Electricity.

Thermo-Electricity (Ueber Thermoelektricität). C. Liebenow. An address delivered before the Electrotechnical Society, Berlin. Principally theoretical, giving a formula for thermo-e. m. f. 4000 w. Elektrotech Zeitschr—March 22, 1900. No. 33509 B.

GENERATING STATIONS.

Accumulators.

The Charging of Accumulators at Constant Pressure (Ueber die Ladung von Akkumulatoren bei Konstanter Spannung). C. Heim. A paper presented at a meeting of the German Electrical Engineers' Association in Hanover, containing a long discussion of the subject, with tables and curves. Serial. Part I. 3200 w. Elektrotech Zeitschr—April 5, 1900. No. 33514 B.

Bolton.

Bolton Corporation Combined Lighting and Traction Works. Illustrated detailed description. 1800 w. Elect'n, Lond

—March 30, 1900. Serial. 1st part. No. 33612 A.

Brushes.

The Boudreaux Laminated Brushes at Low Voltages (Die Boudreaux-Blætterbuerste bei Niederer Spannung). Dr. G. Langbein. An article showing the disadvantage of using brushes made of antifriction metal on low voltage dynamos, on account of their high resistance. 700 w. Elektrotech Zeitschr—March 22, 1900. No. 33506 B.

Hydraulic Generation.

Direct-Connected Waterwheels and Generators. Frank C. Perkins. Illustrates and describes examples of the use of impulse-wheels, and pressure turbines for direct-connection with electrical generators, with remarks on efficiency. 1300 w. W Elect'n—April 14, 1900. No. 33676.

Lausanne.

The Electric Plant of the City of Lausanne (Les Installations Eléctriques de la ville de Lausanne). An account of the plant now being constructed for this Swiss city. Power is derived from the Rhone and the current led 35 miles to the city. 1200 w. Schweiz Bauzeitung—March 24, 1900. No. 33537 B.

Machinery.

650 K. W. Ferranti-Plenty Plant. Illustrated description of the latest unit which has been added to the equipment of the central station of the London Electric Supply Corporation at Deptford, Eng. 2300 w. Engr, Lond—April 13, 1900. No. 33780 A.

Multipolar.

Advantages of Multipolar Construction. Alton D. Adams. Compares the multipolar and bipolar machines, discussing the advantages of the former. 2700 w. W Elect'n—April 14, 1900. No. 33675.

Niagara Power.

New Wheel Pit of the Niagara Falls Power Co.'s Power Plant at Niagara Falls, N. Y. O. E. Dunlap. Information concerning this work, which when completed will give this company a total of 105,000 H. P. Ill. 1200 w. Eng News—April 5, 1900. No. 33453.

The Work of the Tonawanda Power Company. Illustrates and describes the transforming of Niagara power for motors, converting it for railway use, and regenerating it for arc and incandescent lighting. 4200 w. Am Elect'n—April, 1900. No. 33402.

Operation.

Operation of Electric-Lighting Plants from a Business Standpoint. A. E. Judge. Read before the Southwestern Gas, Electric, and Street Railway Assn. Discusses in detail the need of guarding against accident, stoppage, etc., accounts, employees, expenses, prices, etc. 1700 w. Am Gas Lgt Jour—April 23, 1900. No. 33766.

Paris Exposition.

The International Central Station at the Paris Exposition (Mittheilungen über die Internationale Electricitätsstation in der Weltausstellung Paris, 1900). Dr. O. Fauerlain. An illustrated description of the great international generating plant on the Champ de Mars, with an output of over 20,000 kw. 2000 w. Elektrotech Zeitschr—April 12, 1900. No. 33516 B.

Power Plant.

The Electrical Power Plant of the Armour Packing Houses in Chicago. Stephen H. Goddard. Brief illustrated description of an isolated plant. 1500 w. Elec Rev, N. Y.—April 25, 1900. No. 33846.

See also Power Station under Street and Electric Tramways.

Rates.

Methods of Charging for Public Supply of Electricity. W. W. Lackie. Abstract of a paper read before the Glasgow Section of the Inst. of Elec. Engs. Discusses the methods at present in use, and the basis on which they were founded, and the means of securing a uniform rate. 2500 w. Elect'n, Lond—April 6, 1900. No. 33690 A.

Station.

Large Central Station for Denver, Col. J. W. Dickerson. Information concerning a new station for supplying electric light to the entire city, the cost, etc. 1400 w. Elec Wld & Engr—April 21, 1900. No. 33765.

Some Statistics Relating to Electric Power Production. Philip Dawson. The first of a series of articles showing the importance of properly laying out and working electrical stations, comparing various systems and the practice in different countries. 1800 w. Engng—April 6, 1900. Serial. 1st part. No. 33697 A.

Storage Batteries.

Advantages of Storage Batteries in Power Houses (Wirkungen und Vortheile von Pufferbatterien in Bahnbetrieben). A short article on the advantages of storage batteries for small power houses with varying loads. 700 w. Ill. Zeitschr f Klein u Strassenbahnen—March 16, 1900. No. 33577 C.

Supply Works.

Doncaster Electricity Supply Works. Part first gives an account of the town, and begins an illustrated description of the works. 1600 w. Elec Engr, Lond—

April 6, 1900. Serial. 1st part. No. 33692 A.

Greenock Corporation Electricity Works. Illustrated detailed description of these works, and also of the Babcock and Wilson chain grate stoker and steam superheater in use. 2800 w. Elec Rev, Lond—March 30, 1900. No. 33613 A.

The Willesden Electricity Works of the Metropolitan Electric Supply Company, Limited. Illustrated description of an important plant. 2400 w. Elec Rev, Lond—March 23, 1900. Serial. 1st part. No. 33381 A.

York Electricity Supply Works. An outline history of the electric-lighting scheme, with illustrated technical description of the plant installed. 2500 w. Elec Eng, Lond—March 23, 1900. Serial. 1st part. No. 33380 A.

LIGHTING.

Car Lighting.

Electric Lighting on Prussian Railway Postal Cars. From *Der Electro-Techniker.* Information relating to the advantages of using the electric light on postal cars, and the success which has led to the decision to use it on all such cars in Prussia. 1800 w. R R Car Jour —April, 1900. No. 33649.

Combination.

Combined Engine and Dynamo. Brief illustrated description of the combined engines and dynamo of the Hull Electric Lighting Station. 900 w. Engr, Lond—March 23, 1900. No. 33397 A.

Enclosed Arcs.

Arc Lighting (L'Eclairage par Arc). A. Bochet. A general article, with special attention to enclosed arcs. 1900 w. Génie Civil—March 17, 1900. No. 33590 D.

Gas Coke.

Gas Coke for Electric Lighting. Alton D. Adams. A comparison of the values of the gas and of the electric energy that may be derived from coke. 2000 w. Elec Wld & Engr—April 28, 1900. No. 33892.

Lamps.

Incandescent Lamps. Francis W. Willcox. Describes in detail some of the important and interesting features in the development. Ill. 4800 w. Jour Fr Inst —April, 1900. Serial. 1st part. No. 33343 D.

St. Petersburg.

The Electric Lighting of St. Petersburg. An illustrated description of the station and network of the Electricité et Hydraulic de Charleroi Company. 1200 w. Elec Rev, Lond—April 6, 1900. Serial. 1st part. No. 33693 A.

Train Lighting.

Dick's System of Electric Lighting for Trains (Dick's Elektrische Zugsbeleuchtung). L. Kohlfürst. An illustrated account of this system, which derives current from a dynamo geared to the car axle, with comparisons of the cost with that of other systems of train lighting. 2000 w. Schweiz Bauzeitung—March 31, 1900. No. 33538 B.

MEASUREMENT.

Alternating Currents.

The Use of Hot-Wire Shunt Instruments as Alternating Ammeters. E. A. Wagner. Explanation of method. 600 w. Am Elect'n—April, 1900. No. 33403.

Alternating Curves.

A New Method of Tracing Alternating Curves. Discussion of paper by Fitzhugh Townsend. 4500 w. Trans Am Inst of Elec Engs—March, 1900. No. 33770 D.

Charges.

Commercial Electrical Measurements and Prices. William D. Marks. Explains a simple system for determining the cost and selling price of electricity. 3200 w. Elec Wld & Engr—April 28, 1900. Serial, 1st part. No. 33891.

Dynamometer.

An Electric Brake Dynamometer (Ein Elektrisches Bremsdynamometer). Prof. A. Grau. An illustrated description of a dynamometer in which the braking effect is due to a copper disc rotating in a magnetic field. 1200 w. Elektrotech Zeitschr —April 5, 1900. No. 33512 B.

Electric Waves.

Application of the Radio-Micrometer to the Measurement of Short Electric Waves. G. W. Pierce. An illustrated description of an apparatus found to be useful in quantitative experiments on electric waves. 2300 w. Am Jour of Sci —April, 1900. No. 33344 D.

Measurements.

Electrical Measurements. John Hertner. Makes comparison of the action of current in a wire with the flow of water in a pipe, explains the fundamental units, etc. 2000 w. Engr, U. S. A.—April 15, 1900. No. 33747.

Standards.

Electrical Standards. Frank A. Wolff, Jr., in *Science.* Concerning the facilities afforded by the office of standard weights and measures for the verification of electrical standards and electrical measuring apparatus. 2200 w. Elec Rev, N. Y.—April 4, 1900. Serial. 1st part. No. 33413.

Station Tests.

Portable Direct Current Measuring Instruments for Station Tests. Harris J. Ryan and E. L. West. Part first treats

of the details of construction of direct-current instruments. Ill. 5000 w. Sib Jour of Engng—April, 1900. Serial, 1st part. No. 33809 C.

Testing.

Differential Testing with Single-Coil Instruments. George T. Hanchett. Illustrates and describes methods of measuring. 800 w. Am Elect'n—April, 1900. No. 33404.

POWER APPLICATIONS.

Controller.

A Regenerative Controller. John C. Henry. Describes the development of the controller, giving a diagram of connections and tabulated results of comparative tests, and notes the suitability of this method of control for automobiles. 1000 w. Elec Wld & Engr—March 31, 1900. No. 33355.

Cranes.

New Electric Cranes (Neuere Elektrische Hebezeuge). An illustrated account of some new electric cranes and their details. 1500 w. Zeitschr d Ver Deutscher Ing—March 31, 1900. No. 33559 D.

Electrical Driving.

Electrical Driving of Factories from the Public Point of View. Alfred H. Gibbings. Read before the Northern Soc. of Elec. Engs., Manchester, Eng. Gives tabulated list showing the extent to which the electric motor has been adopted in England, with remarks on the economy effected. 3500 w. Elec Rev, Lond—March 30, 1900. No. 33615 A.

Induction Motors.

Notes on Single-Phase Induction Motors and the Self-Starting Condensing Motor. Discussion of paper by Charles Proteus Steinmetz. 500 w. Trans Am Inst of Elec Engs—March, 1900. No. 33771 D.

Mill Power.

Induction Motors at Lancaster Mills. Frank C. Perkins. Illustrates and describes the electric motors installed in mills at Clinton, Mass., stating some of their advantages. 900 w. W Elect'n—March 31, 1900. No. 33359.

Mining Plant.

Electric Power and Lighting Plant at the Hollertszug Iron Mine, near Herdorf, Germany (Elektrische Kraftübertragungs und Beleuchtungsanlage der Eisenerzgrube "Hollertszug" bei Herdorf an der Sieg). C. Pfankuch. An illustrated description of this plant, in which the current is applied in various ways. 2000 w. Ill. Zeitschr f Klein u Strassenbahnen—April 1, 1900. No. 33578 C.

Electrically Driven Machinery Used in Sinking a Shaft at the Rheinelbe and Alma Mine, Germany (Elektrisch Angetriebene Maschinen beim Abtenfen des Schachtes Rheinelbe II., der Zeche Vereinigte Rheinelbe und Alma). Illustrated description of the electric plant for driving the shaft-sinking machinery and pumps. 2000 w. 2 plates. Glückauf—April 7, 1900. No. 33572 B.

Power.

Power Development from the Drainage Canal. A statement of the plans for utilizing the 20,000 H. P. afforded by the Chicago Canal. 600 w. Eng Rec—April 7, 1900. No. 33417.

Rotaries.

A Means of Fixing the Frequency of Inverted Rotaries. Describes an ingenious arrangement for preventing rotary converters, deriving their power from a source of direct current and generating alternating current, from fluctuating in speed when their field strength is affected by variations of the power factor of the alternating-current output. 1800 w. Elec Wld & Engr—April 7, 1900. No. 33492.

Rotary Transformers (Ueber rotirende Umformer). H. S. Meyer. An article on the practical application of these machines, with diagrams. 1700 w. Elektrotech Zeitschr—April 5, 1900. No. 33513 B.

Storage Batteries.

The Use of the Storage Battery in the Theatre. On the advantages and adaptability of storage batteries. 1500 w. Am Elect'n—April, 1900. No. 33405.

Tool Driving.

Electric Driving for Heavy Machine Tools. Statements of power found by direct experiment to be absorbed by certain heavy machine tools, with diagrams. The investigations were made at the Atlas Works, Sheffield. 2000 w. Engr, Lond—March 23, 1900. No. 33396 A.

TRANSMISSION.

California.

Electric Power Transmissions of Southern California. Map and facts of interest concerning the sections covered, routes, methods of securing reliability in the service, etc. 2300 w. Jour of Elec—March, 1900. No. 33671.

Duluth.

Power Transmission Schemes at Duluth, Minnesota. Frank W. Springer. Considers the schemes for utilizing as water power the St. Louis and the Black rivers. Ill. 1300 w. Elec Wld & Engr—April 14, 1900. No. 33664.

Electric Power.

The Basis of Electric Power Transmission. R. B. Williamson, W. B. Potter, M. G. Starrett, R. L. Russell, and W. B.

Reed. Interesting addresses, with illustrations. 15000 w. N. Y. R R Club—Feb. 15, 1900. No. 33487.

Long-Distance.

The Limitations of Long-Distance Power Transmission. W. E. Goldsborough. Considers the success attained in this field and various matters relating to the development, predicting that power can be delivered at distances of 500 miles from the generating station. 1500 w. Elec Rev, N. Y.—April 18, 1900. No. 33745.

Phono-Electric Wire.

New Wire for Trolley and Other Purposes. F. Z. Maguire. Gives a report of tests showing the fundamental properties of phono-electric wire, a comparison with other wires, and the claims made for this new material. 800 w. Elec Rev, Lond—April 6, 1900. No. 33694 A.

Polyphase.

See same title under Street and Electric Tramways.

MISCELLANY.

Berlin.

The Position and Development of the Electro-technical Industry in Berlin, in 1900 (Die Lage und Entwickelung der Elektrotechnischen Industrie Berlins im Jahre 1900). A general article, giving accounts of various applications of electricity. 2300 w. Die Elektrizität—March 17, 1900. 33568 C.

Military Uses.

Electrical Appliances in Military Operations. Capt. John P. Wisser. A most interesting illustrated exposition of the many uses to which electricity is put in the military field, with descriptions of the apparatus and of the method of its use. Ill. 4500 w. The Engineering Magazine—May, 1900. No. 33905 B.

Warfare.

Electricity in War. John Perry. An illustrated account of some of the work and training of the British Electrical Engineer Volunteer Corps. 2300 w. Nature—April 5, 1900. No. 33686 A.

GAS ENGINEERING

Acetylene.

The New Gaseous Illuminant, Acetylene, and Its Source of Production, Calcium Carbide. An account of the discovery of acetylene, its nature, cost, efficiency of any process, etc. 2500 w. Ind & East Engr—March, 1900. No. 33653 D.

Appliances.

Gas Appliance Exchanges. Fred R. Persons. Read at meeting of Ohio Gas Light Assn. Reasons why the sale of gas consuming devices should be separated from the gas industry proper. Discussion. 10000 w. Am Gas Lgt Jour—April 2, 1900. No. 33356.

Candle Power.

Address of J. W. Carmichael before the Glasgow meeting of Scottish Gas Managers. Discusses subjects of interest and importance and suggests that the illuminating power of gas in Scotland should be reduced to a uniform standard of twenty candles. Lengthy discussion. 10300 w. Gas Wld—April 7, 1900. No. 33689 A.

Freezing.

Dr. Bueb's Method of Preventing Freezing in Gas Services. Discusses this method, which consists in the addition of vaporized alcohol to the gas. 2000 w. Jour Gas Lgt—April 3, 1900. No. 33611 A.

Illumination.

A Simple Illumination Photometer. Describes interesting examples of modern illumination, and notes the need of a means of measuring. Illustrates and describes the construction of a simple photometer and the method of using. 2000 w. Sci Am Sup—April 14, 1900. No. 33683.

The Elements of Illumination. Louis Bell. Considers some of the fundamental principles, optical, physiological and æsthetic, which underlie the proper use of artificial illuminants, and how to adapt them to existing conditions. 2000 w. Elec Wld & Engr—April 14, 1900. Serial. 1st part. No. 33665.

The Production of Light by Electricity and Gas. Ed. C. de Segundo. A discussion of the relative merits of gas and electric lighting. 1800 w. Elec Rev, Lond—April 6, 1900. Serial. 1st part. No. 33695 A.

Inclined Retorts.

The Carbonization of Coal for the Production of Illuminating Gas. W. R. Herring. Read at the Edinburgh meeting of the Royal Scottish Soc. of Arts. Discusses the saving in labor and expense brought about by the application of the force of gravity to the charging of coal-gas retorts. 2800 w. Jour Gas Lgt—April 3, 1900. No. 33610 A.

Injurious Effects.

The Deterioration of Leather Bookbindings. Extract from a paper by Douglas Cockrell at a meeting of the London Soc. of Arts. The conclusion reached was that gas is not the chief cause of damage, that it is likely to be in some degree injurious

is admitted, and the need of proper ventilation shown. 1500 w. Jour Gas Lgt—April 17, 1900. No. 33875 A.

London.

The Rise and Development of the London Gas Supply. W. J. Liberty. Read at meeting of the Gas Engineering Soc., London. Abstract. Reviews the history of the companies. 1800 w. Jour Gas Lgt—March 20, 1900. No. 33310 A.

Meters.

Prepayment Meters. John D. McIlhenny. Read at meeting of Ohio Gas Light Assn. A discussion of results, cost, etc. 5000 w. Am Gas Lgt Jour—April 9, 1900. No. 33486.

Naphthalene.

Estimation of Naphthalene in Coal Gas. Harold G. Colman and J. F. Smith. Paper read at meeting of the Nottingham Section of the Soc. of Chem. Ind. An explanation of a method devised by the writers. Ill. 2000 w. Jour Gas Lgt—March 27, 1900. No. 33444 A.

Naphthalene and Coal Gas. An interview with William Young, discussing the novel theory recently presented in a paper by R. W. Allen. 3000 w. Gas Wld—March 31, 1900. No. 33608 A.

Natural Gas.

Natural Gas. Southard Hay. Brief account of the geological conditions upon which the occurrence seems to depend, the simple machinery required for its storage and transmission, and the extent and convenience of its use. 2000 w. Yale Sci M—April, 1900. No. 33607 C.

Purification.

Some New Ideas About Oxide Purification. B. E. Chollar. Read at meeting of Ohio Gas Lgt. Assn. A short paper and lengthy discussion. 3800 w. Am Gas Lgt Jour—April 16, 1900. No. 33661.

Street Lighting.

Street Lighting. Andrew Hickenlooper. Address at meeting of the Ohio Gas Light Assn. Interesting historical review, with general discussion. 16800 w. Am Gas Lgt Jour—April 9, 1900. No. 33485.

Supply.

By-Product Coke Ovens as a Source of Gas Supply. Peter Young. Compares the cost of oven and retort plants, and gives information concerning the two coke-oven plants on the American continent supplying illuminating gas. Discussion. 3300 w. Am Gas Lgt Jour—April 16, 1900. No. 33662.

Underground Water.

The Law in Regard to Underground Water. J. Shiress Will. Read at meeting of the Surveyors' Inst., London. Reviews the English law with regard to the ownership of underground water, discussing cases, and among them the Jordeson Gasholder Case. 10500 w. Jour Gas Lgt—March 20, 1900. No. 33309 A.

Water Gas.

The Future of Water Gas in France. Just Alix. Part first consists of an introductory review of the gas industry, with some interesting figures relating to water gas, and the results obtainable with particular process and apparatus. 2000 w. Jour Gas Lgt—April 17, 1900. Serial. 1st part. No. 33849 A.

MARINE AND NAVAL ENGINEERING

Armor Plate.

See Mining and Metallurgy, Iron and Steel.

Balancing.

Graphic Method of Balancing Marine Engines. J. Macfarlane Gray. Description of method, with remarks. 1200 w. Engng—April 13, 1900. No. 33775 A.

Battleship.

The Imperial Japanese Battleship "Asahi." Illustrated detailed description, with comparison and comments. 1700 w. Engr, Lond—April 13, 1900. No. 33782 A.

The Japanese Battleship "Asahi." Illustration, with some general particulars and results of the speed trials. This is the largest battleship afloat. 1200 w. Engng—April 6, 1900. No. 33699 A.

Boilers.

Naval Boilers. Editorial discussion of the defects of the water-tube boiler, but advocating it for marine use. 1800 w. Engr, Lond—March 9, 1900. No. 33388 A.

British Engineers.

Naval Engineers. Editorial discussion of paper by D. B. Morrison. 3500 w. Engng—April 6, 1900. No. 33701 A.

The British Naval Engineer: His Present Position and Influence on Our Sea Power. D. B. Morison. Discusses the education and training; duties and responsibilities; present position, pay, etc. 16000 w. Brit Inst of Marine Engs & Naval Archs, Adv Proof—March 30, 1900. Also Engng—April 6, 1900. Serial. 1st part. No. 33477 E.

British Navy.

Admiralty Engineering. Considers in detail some of the aspects of engineering practice of the British Admiralty. 3600 w. Engr, Lond—March 30, 1900. Serial. 1st part. No. 33618 A.

Coaling Vessels.

The Miller Cableway for Coaling Vessels at Sea. Illustrated description of the device and its operation, with remarks. 2000 w. Eng News—April 5, 1900. No. 33450.

Commerce Destroyers.

The Commerce Destroyers (Les Croiseurs Corsaires). A short description of the new French 23-knot, 8,000-ton cruisers, with a discussion of their advantages and disadvantages. 1000 w. Le Yacht—March 17, 1900. No. 33851 C.

Comparison.

American Freight Locomotives and the Engines of the "Oceanic."—A Comparison of Horse Power. An interesting comparison of marine engines and locomotive horse power, with illustrations. 1800 w. Sci Am—March 31, 1900. No. 33365.

Cruiser.

U. S. Steel-Sheathed Protected Cruiser "Albany," Built at Elswick. Illustrated description. 500 w. Marine Engng—April, 1900. No. 33478 C.

Defense.

Warships and Seacoast Batteries. Operations of the American Squadron at Santiago de Cuba. Translated from the *Revue d'Artillerie* for April, 1899. Discussion. 4300 w. Jour U. S. Art—March-April, 1900. No. 33627 D.

Deutschland.

The Hamburg-American Atlantic Liner "Deutschland." Brief illustrated description. 800 w. Engng—March 23, 1900. No. 33389 A.

Ferryboats.

Coal Economy of Screw Ferryboats. E. A. Stevens. Treats of the type with one screw at each end, and takes four boats as examples, giving the conclusions reached. 1200 w. Stevens Ind—April, 1900. No. 33834 D.

Pennsylvania R. R. Ferryboats at New York. Illustrated detailed description of these fine boats. 600 w. Ry & Engng Rev—April 7, 1900. No. 33498.

Ferry Steamer with an Elevating Deck. Illustrated description of a vessel for service in Glasgow harbor, with an elevating deck, so that the deck may be brought to the same level as the quay at all stages of the tide. 1000 w. Sci Am—April 7, 1900. No. 33409.

Fouling.

The Fouling of Ships. W. H. Atherton. Read before the Northeast Coast Inst. of Engs. & Shipbuilders. Deals with the nature of fouling, the effect, and prevention. 3900 w. Engs' Gaz—April, 1900. No. 33605 A.

French Navy.

Launching of the "Montcalm," the "Dupleix," and the "Yatagan" (Lancement du "Montcalm," der "Dupleix," et du "Yatagan"). A short description of two armored cruisers and a torpedo boat destroyer, recently launched in France. 600 w. Le Yacht—March 31, 1900. No. 33852 C.

The Naval Policy of France (Après Fachoda: La Politique Navale de la France). Lieut. Emile Duboc. A criticism of the French naval programme, with a strong plea for a commerce-destroying policy in case of war with England. 5000 w. Questions Diplomatique et Coloniales—March 15, 1900. No. 33854 C.

Japanese Battleship.

The Japanese Battleship "Shikishima" (Le Cuirassé Japanis Le "Shikishima"). A short account of this fine man-of-war, with two illustrations. 600 w. Le Yacht—March 31, 1900. No. 33853 C.

Jananese Navy.

The Imperial Japanese Navy. C. C. P. FitzGerald. Read before the Inst. of Nav. Archts. Reviews the history of this navy, its rise and development. 2800 w. Engng—April 6, 1900. No. 33702 A.

Light-Draught Steamers.

The Increasing Demand for Light-Draught Steamers. Waldon Fawcett. Reviewing the rapid extension in the use of boats of this type, the mechanical and marine problems solved in the construction, and presenting important examples built in many shipyards. Ill. 3000 w. The Engineering Magazine—May, 1900. No. 33901 B.

Liner.

The North German Lloyd Liner "Kaiserin Maria Theresia." Illustrated description of the reconstructed steamship, which has had 66 feet of the hull introduced amidships, and been thoroughly overhauled. 900 w. Sci Am—March 31, 1900. No. 33364.

The Launch of the Ocean Liner La Savoie (Le Lancement du Paquebot "la Savoie"). A brief illustrated description of this fine addition to the fleet of the *Compagnie Générale Transatlantique*. 600 w. Génie Civil—April 7, 1900. No. 33594 D.

Narrow Channels.

Accidents to Vessels in Narrow Channels and the Proposed Great Lakes and Atlantic Ship Canal. Relates three recent accidents illustrating the defects and de-

lays in the passage through narrow channels. 800 w. Eng News—April 19, 1900. No. 33729.

Naval Engineers.

French Naval Engineers. The position of the naval engineers in France is explained and the demands for increased numbers, better pay, and improved status. 1300 w. Engr, Lond—April 13, 1900. No. 33777 A.

Propellers.

Notes on Reversing Screw Propellers. The good qualities of propellers with reversible blades are presented and points discussed. 2400 w. Prac Engr—April 6, 1900. No. 33688 A.

Revenue Cutter.

Single Screw U. S. Revenue Cutter for the Great Lakes. Illustrated description of the vessel for the construction of which bids were recently opened at Washington. 1100 w. Marine Engng—April, 1900. No. 33481 C.

River Steamboat.

The First Class Passenger Steamboat "Kaiserin Auguste Victoria" (Der Salondampfer "Kaiserin Auguste Victoria"). A fully illustrated description of the boat and her engines. She runs on the Rhine. 2500 w. 2 plates. Zeitschr d Ver Deutscher Ing—March 24, 1900. No. 33555 D.

Rolling of Ships.

The Rolling of Ships on Waves. G. Russo. Read before the Inst. of Nav. Archts. The author's experimental method is described and results given. The apparatus used is illustrated and the principles explained. 3500 w. Engng—April 6, 1900. Serial. 1st part. No. 33700 A.

Russian Cruiser.

The First Class Russian Cruiser "Askold" (Der Russische Kreuzer I. Klasse "Askold"). A short illustrated description of this new 6000 ton cruiser, built at the *Germania* yard. 500 w. Stahl und Eisen—April 1, 1900. No. 33546 D.

School Ship.

The Engines of the Corvette "General Baquedano." Magnus Sandison. Illustrated description of the propelling engines, which possess some novel features. The vessel being a training ship, it was desirable that it be able to steam economically at low speeds. 1800 w. Engr, Lond—April 13, 1900. No. 33779 A.

Shipbuilding.

Shipbuilding in Navy Yards. Francis T. Bowles. Discusses the advantages and disadvantages. 2800 w. Naut Gaz—April 12, 1900. No. 33678.

Shipping and Shipbuilding in the United States. James W. Ross. Historical review of the rise and fall of this industry, and the present outlook. 4000 w. Sci Am Sup—April 28, 1900. No. 33831.

The Future of Ship Building. Charles H. Cramp. From *Harper's Weekly*. A review of the past history of this industry in America, and facts concerning Germany and Great Britain. 2000 w. Marine Rev—April 26, 1900. No. 33896.

The Practical Results of Some Innovations in Modern Shipbuilding. Henry B. Wortley. Read before the Inst. of Nav. Archts. Gives results of recent departures from ordinary practice, such as a rudder hung so that no stern frame has been required; the substitution of two pillars in the main hold in the place of numerous stanchions; a 3-ft. frame spacing; and the disuse of cement on the ship's bottom inside the ballast tanks. 4700 w. Engng—April 13, 1900. No. 33772 A.

Shipping.

International Competition in Shipping. Editorial on the expansion of British shipping, and the advance by other nations. 500 w. Engng—March 23, 1900. No. 33391 A.

The New Era in Lake Shipping. Waldon Fawcett. Illustrates and describes the latest type of ore vessels, with its carrying capacity of 8000 or 9000 tons, and reviews interesting developments. 2000 w. Eng & Min Jour—April 21, 1900. No. 33751.

Steamboat.

Magnificent Passenger Steamboat. Description of the "Tashmoo," a fine boat on the Great Lakes. 1100 w. Naut Gaz—April 5, 1900. No. 33447.

For Lake Michigan Service. Illustration and description of new Goodrich Line passenger steamer, with remarks on the attention given to life-saving appliances. 2000 w. Marine Rev—April 12, 1900. No. 33673.

New Steel Southern Steamer. Illustrated description of the "H. B. Plant," built by the Merrill-Stevens Engng. Co. 2200 w. Naut Gaz—April 26, 1900. No. 33847.

Steamship Service.

Wanted: Direct Steamship Service with Syria and Egypt. Explains the need of direct merchant steamers at regular intervals, in the interest of trade. 1000 w. U. S. Cons Repts, No. 709—April 20, 1900. No. 33732 D.

Steering.

Is the Steering of the Modern Screw-Propelled Vessel Defective? Cornelius W. McKay. Discusses the control of twin-screw ships. 3500 w. Sci Am Sup—March 31 and April 7, 1900. Serial. 2 parts. No. 33372.

Trans-Siberian Route.

The Marine Department of the Trans-

Siberian Railroad. Waldon Fawcett. Information concerning the boats which will serve as connecting lines in the breaks of rail line, with illustrations. 1400 w. Sci Am—March 31, 1900. No. 33366.

Trial Analysis.

Analysis of the Speed-Trial of the Twin-Screw Steam Yacht "Sovereign" by D. W. Taylor's Method of Trial Analysis. Robert S. Haight. Graduation thesis. Compares results by Taylor's method with those obtained by following Rankine's theory of the screw propeller. 1800 w. Stevens Ind—April, 1900. No. 33835 D.

Turrets.

The Superposed Turrets of the "Kearsarge." Illustrated description, with amount of test made to determine whether the structure could sustain the heavy strain while firing the guns. 1700 w. Sci Am—April 14, 1900. No. 33681.

Warship Equipment.

The Electrical Equipment of Ships of War. C. E. Grove. A record of what has already been accomplished, and the developments where it is likely to be applied. The practice of the British Admiralty is taken as a basis of the discussion. Ill. 10000 w. Brit Inst of Elec Engs, Adv Proof—April 5, 1900. No. 33476 E.

Wrecking.

The Use of Acetylene in Raising Sunken Vessels. Suggests the use of this gas, and gives illustrated description of apparatus to be used. 500 w. Sci Am—April 28, 1900. No. 33827.

Yacht.

Gasoline Yacht "Lady Francis." Drawings, photographs and description of a handsome vessel of this type recently completed. 700 w. Marine Engng—April, 1900. No. 33480 C.

Typical Forms of Racing Yachts. J. R. Barnett. Read before the Inst. of Engs. and Shipbuilders. Illustrations, with comparison of types and general remarks. 2300 w. Engs Gaz—April, 1900. No. 33604 A.

MECHANICAL ENGINEERING

AUTOMOBILISM.

Accumulators.

Competitive Tests of Accumulators by the Automobile Club of France (Concours d'Accumulateurs de l'Automobile Club de France). A. Bainville. An account of the tests made, with criticisms. 1400 w. L'Electricien—April 7, 1900. No. 33588 B.

Autocars.

The Autocar of To-day in Europe and America. Henry Sturmey. Read before the Automobile Club of Great Britain and Ireland. Reviews the advances made, the types used, the progress in different countries, etc. 3000 w. Automotor Jour—April, 1900. No. 33796 A.

Cab.

The Vedovelli and Priestley Cab. From *L'Industrie Electrique*. Illustrates and describes a vehicle interesting both in the method of steering and form of the body. 700 w. Sci Am Sup—April 14, 1900. No. 33684.

Comparisons.

A Lecture on Automobiles. Hiram Percy Maxim. Abstract of an address at the Knickerbocker Athletic Club of N. Y. Interesting comparisons of electric, gasoline and steam vehicles. 1300 w. Elec Rev. N. Y.—March 28, 1900. No. 33314.

De Dion Motor.

The De Dion Motor and Its Antecedents. Outline history of the light and heavy oil-engine, considering the De Dion and Bouton patents. 2800 w. Automotor Jour—April, 1900. No. 33792 A.

Delivery Wagons.

Power Consumption and Operative Costs of Automobile Delivery Wagons. George F. Sever. A study of the comparative costs of operation and maintenance of horse and electric delivery wagons for city service. 1300 w. Elec Rev, N. Y.—March 28, 1900. No. 33312.

Europe.

Automobilism in Europe. C. L. Durand. The principal automobile events in Europe during the Paris Exposition. 1500 w. Elec Rev, N. Y.—March 28, 1900. No. 33313.

Gasoline.

A Gasoline Carriage for Physicians. Illustrated description of the "Aesculapius," a recently exhibited vehicle. 400 w. Auto Mag—April, 1900. No. 33335 C.

Ignition.

Electric Ignition of Petrol Motors. E. C. Rimington. Considers briefly the principles of the induction coil, which is used to obtain the spark in the cylinder of the engine, the construction and the causes of failure to insure ignition. 2700

w. Automotor Jour—April, 1900. No. 33793 A.

Light Carriages.

The Light Road Carriage. Edward de Nôreme. Discusses the class termed by the Frenchmen a "voiturette," illustrating various types and describing the characteristic features. 2500 w. Auto Mag—April, 1900. No. 33333 C.

Oil Motor.

The Dawson Oil Motor. A general description explaining the principles, with a detailed account of its construction. Ill. 1700 w. Automotor Jour—April, 1900. No. 33791 A.

Oils as Sources of Energy in Explosion Engines. The advantages of the oil-engine are discussed, the merits of different oils as heating agents, the types of engine used, etc. 1800 w. Automotor Jour—April, 1900. No. 33795 A.

Omnibuses.

Automobile Omnibuses for Service in Cities. Describes types used in European cities, illustrating two of them. 500 w. Sci Am Sup—April 28, 1900. No. 33830.

Paris.

The Competition of the Automobile Club of France (II. Concours des Voitures de Place Automobiles). G. Forestier. The full report of the commissioners, with many illustrations and tablets, on this competitive exhibition, held in June, 1899. Serial. Part I. 7000 w. Génie Civil—March 24, 1900. No. 33591 D.

Progress.

The Practical Automobile of the Future. E. E. Schwarzkopf. In praise of the fore-carriage and its economy. Ill. 1100 w. Auto Mag—April, 1900. No. 33334 C.

Races.

Two Automobile Road Races. An account of the races of March 31 and April 14. 1900, organized by the Automobile Club of America. 2500 w. Auto Mag—May, 1900. No. 33897 C.

Steam Car.

The Gardner-Serpollet Steam Car. Brief illustrated description. 600 w. Automotor Jour—April, 1900. No. 33794 A.

Trials.

Motor Carriage Trials. E. C. Oliver. Describes apparatus for testing automobiles, and the method of conducting such trials so that all conditions shall be kept constant, and results comparable. 2500 w. Horseless Age—April 18, 1900. No. 33743.

MACHINE WORKS AND FOUNDRIES.

Air-Hoist.

A Self-Propelling Air Hoist, with Unlimited Travel. Illustrated description of a novel apparatus and its operation. 900 w. Am Mach—April 26, 1900. No. 33814.

Bearings.

Roller and Ball Bearings. J. B. Detwiler. Read before the Mech. Supts.' Assn. Review of progress made in the use of these bearings, noting some of the interesting applications. 2000 w. Can Engr—April, 1900. No. 33680.

Belts.

Machine-Shop Belts. E. J. Armstrong. Suggestions concerning the care and attention needed to secure the maximum output. 1000 w. Am Mach—April 12, 1900. No. 33635.

Boring Machine.

The Universal Boring and Thread-cutting Machine of Paul Langbein (Universalbohr-und Gewindeschneid-maschine von Paul Langbein in Sarauno, Italien. D. R. P. 108990). A well illustrated account of a handy and serviceable tool which can be driven by belt or electric motor. 1300 w. Glaser's Ann f Gew u Bauw—March 15, 1900. No. 33523 D.

Castings.

Shot Iron and Hard Spots in Castings. Edward Kirk. Discusses the value of dump iron, showing it to be more economical to save only the larger pieces. Gives numerous experiments made in trying to utilize this material. 4000 w. Foundry—April, 1900. No. 33346.

Shrinkage of Malleable Iron Castings. H. O. Evans. Read before the Foundrymen's Assn., at Philadelphia. A reply to Dr. Moldenke's critique of Mr. Davis' paper. 1100 w. Ir Age—April 12, 1900. No. 33629.

Yellow Metal Castings. P. Longmuir. Suggestions for obtaining good results in this class of castings. Ill. 900 w. Foundry—April, 1900. No. 33349.

Cupolas.

A New Cupola Lining. Illustrated description of a lining formed of specially designed, hollow, cast-iron bricks. 1000 w. Engr, Lond—March 23, 1900. No. 33394 A.

Cutter.

A Pneumatic Boiler-Tube Cutter. Illustrates and describes a special tool operated by compressed air. 350 w. Am Mach—April 19, 1900. No. 33721.

Foundings.

Cast Iron in Foundings. Edward Kirk. How metalloids may be removed and how preserved while metal is in molten state. 1400 w. Am Mfr & Ir Wld—April 26, 1900. No. 33895.

Foundry Equipment.

Design and Equipment of Foundries.

R. P. Cunningham. Discusses the recent improvements in foundry construction and equipment. 2000 w. Foundry—April, 1900. No. 33347.

Gluing.

Purdue University Steaming and Gluing Apparatus. J. D. Hoffman. Illustrated description. 400 w. Am Mach—April 12, 1900. No. 33636.

Jigs.

A Novel Drill Jig. Joseph V. Woodworth. Illustrated description of the jig and its use. 400 w. Am Mach—April 12, 1900. No. 33634.

Joints.

Joints. Eli H. Pearce. Illustrated discussion of the care needed to make good joints in castings. 600 w. Foundry—April, 1900. No. 33348.

Molding.

Making Follow Boards. L. C. Jewett. Describes in detail the making of follow boards, and the materials used. 1100 w. Am Mach—April 26, 1900. No. 33813.

Molding a Large Planer Platen Without a Pattern. R. H. Palmer. Illustrates and describes the method used. 1400 w. Am Mach—April 19, 1900. No. 33722.

Power Consumption.

Power Consumption of Machine Tools (Kraftverbrauch von Arbeitsmaschinen). H. Loch. An article giving the power consumed by a great variety of machines, driven by electric motors, in the railway shops at Gleiwitz, Germany. 1200 w. Glaser's Ann f Gew u Bauw—April 1, 1900. No. 33525.

Rifle Barrels.

The Manufacture of Military Rifle Barrels. E. G. Parkhurst. Illustrated detailed description of the work as carried out by the Pratt & Whitney Co. 5000 w. Am Mach—April 26, 1900. No. 33812.

Shop Design.

New Saw-Tooth Roof Construction (Neue Sägedachanordnung). E. Förster. An illustrated description of the Nacke machine shops at Koswig, showing how the overhead shafting and cranes are arranged without interfering with the roof construction. 500 w. Zeitschr d Ver Deutscher Ing—March 17, 1900. No. 33552 D.

Shops.

New Shops of the Lodge & Shipley Machine Tool Company. Illustrates and describes five new shops in Cincinnati. 800 w. Am Mach—April 19, 1000. No. 33719.

The New Works of the Gisholt Machine Company. Illustrated detailed description of recently built works. 1000 w. Am Mach—April 12, 1900. No. 33632.

Sub-Presses.

Proportions of Sub-Presses. L. B. Charles. Illustrates and describes designs of this useful tool. 600 w. Am Mach—April 26, 1900. No. 33815.

Wheels.

Designing Spiral Wheels for Given Centers. Robert A. Bruce. Method is described and illustrated by an actual case. Diagrams. 2000 w. Am Mach—April 12, 1900. No. 33633.

Works Management.

Labor Questions in England and America. Charles Buxton Going. A review of the parallelism between the engineers' strike of 1897 and the machinists' strike of 1900, showing the futility of the union-labor efforts in America by their failure in Great Britain. 3600 w. The Engineering Magazine—May, 1900. No. 33898 B.

Manufacturers' Associations, Labor Organizations, and Arbitration. H. W. Hoyt. An example of practical co-operation between employers and trade unions is depicted, and the application of the same principles in other lines is strongly urged. 1800 w. The Engineering Magazine—May, 1900. No. 33899 B.

Works Management for the Maximum of Production. J. Slater Lewis. A discussion of union labor and the wage elements in affecting the cost of manufacturing, and of technical education as an aid in works management. Concluding an important series under this general title. 4500 w. The Engineering Magazine—May, 1900. No. 33900 B.

MATERIALS OF CONSTRUCTION.

Cast Iron.

The Chemistry and Physics of Cast Iron Briefly Considered. J. E. Johnson, Jr. Furnishes information from the large experience of the writer. 2500 w. Am Mach—April 5, 1900. Serial. 1st part. No. 33414.

Tests of the "Work Ability" and the Elasticity of Cast Iron of High Tensile Strength (Versuche über das Arbeitsvermögen un die Elastizität von Gusseisen mit Hoher Zugfestigkeit). C. Bach. Tests to determine the mechanical work per cubic centimeter performed by the pulling apart of the test pieces. 1400 w. Zeitschr d Ver Deutscher Ing—March 31, 1900. No. 33558 D.

Testing the Strength of Cast Iron. Walter J. May. Remarks on means of securing as accurate tests as possible. 1300 w. Col Guard—April 12, 1900. No. 33785 A.

Granular Structure.

The Alteration in the Internal Structure of Iron and Copper Through Changes of Form When Cold and Subsequent Annealing (Die Umwandlung des Kleingefüges bei Eisen und Kupfer durch Form-

änderung im Kalten Zustande und darauf folgendes Ausglühen). E. Heyn. A communication from the National Technical Laboratory, Charlottenburg, giving an elaborate and well illustrated account of the subject, treated microscopically. Serial. Part I. 4200 w. 2 plates. Beitschr d Ver Deutscher Ing—April 7, 1900. No. 33562 D.

POWER AND TRANSMISSION.

Car Dumpers.

Car Dumpers and Their Work. Waldon Fawcett. Illustrated descriptions of improved types of these machines, which transfer the contents of cars to the holds of vessels with a minimum of breakage. 1800 w. Am Mfr & Ir Wld—April 26, 1900. No. 33893.

Conveying Plant.

Electric Traveling Crane and Conveyor Plant. Illustrated description of the traveling electric crane at the Wandsworth supply station, and the other coal-handling mechanism. 1000 w. Engr, Lond—April 6, 1900. No. 33712 A.

Cranes.

A Novel Arrangement of Traveling Crane. The arrangement described has been adopted in works in Chicago. Ill. 400 w. Am Mach—April 19, 1900. No. 33723.

Governing.

Automatic Releasing and Governing Device for a Windmill Pump. Frederic W. Blanchard. Illustrates and describes an ingenious device capable of other applications. 1000 w. Am Mach—April 5, 1900. No. 33415.

Ore Unloader.

The Hulett Automatic Ore Unloader. Waldon Fawcett. Illustrated detailed description of the machine and its operation. 2500 w. Ir Age—April 5, 1900. No. 33400.

Lubrication.

The Effective Lubrication of Journals. F. W. Graham Snook. Shows by actual test that the most common method is extremely inefficient, and results in great preventible loss of mechanical efficiency, and suggests means of avoiding this loss. Ill. 4500 w. The Engineering Magazine—May, 1900. No. 33904 B.

Prony Brake.

An Improved Prony Brake. E. J. Armstrong. Illustrated description. 500 w. Am Mach—April 19, 1900. No. 33720.

Tile Kiln.

Steam Tile-Works at Cadinen (Dampfziegelei auf Cadinen). R. Weber. An illustrated description of the machinery for handling the material at the tile-kilns on the German Emperor's estate of Cadinen, West Prussia. 800 w. Zeitschr d Ver Deutscher Ing—March 17, 1900. No. 33553 D.

Water Power.

Greatest Water Power Development in the World. Illustrates and describes the operations at Sault Ste. Marie, and the mammoth water-power development. 5000 w. Marine Rev—April 5, 1900. No. 33484.

SPECIAL MOTORS.

Binary Engine.

The Binary-Vapor Engine. R. H. Thurston. Gives the recent experiments by Prof. Jorn, described by Mr. Frank Mason, commenting on the results, and giving additional information. Ill. 2000 w. Sib Jour of Engng—April, 1900. No. 33810 C.

"Crankless" Engine.

Ljungstrom's "Crankless" Engine. Illustrated description of this invention of a Swedish engineer. 1700 w. Col Guard—April 6, 1900. No. 33704 A.

Gas Engines.

A New Industrial Situation. Gives the views of Mr. George Westinghouse, and of Mr. R. H. Thurston in regard to the new gas engines and improvements for utilizing gas. Ill. 2500 w. Power—April, 1900. No. 33353.

Gas Engine Progress. C. V. Kerr. Read before the Nat. Assn. of Gas and Gasoline Engine Mfrs., at Chicago. Briefly traces the historical development from the beginning. 6300 w. Mod Mach—April, 1900. No. 33374.

Gas Engine Valves. Herbert L. Towle. Discusses valves opening directly into the cylinder or combustion spaces, considering the types that have been used or attempted. 1000 w. Horseless Age—April 4, 1900. Serial. 1st part. No. 33445.

Large Gas Engines in Modern Power Plants (Grosse Gasmotoren in Modernen Kraftbetrieben). Max Münzel. A paper before the Cologne branch of the *Verein deutscher Ingenieure*, giving a well illustrated description of some large gas engine power plants. 4200 w. Zeitschr d Ver Deutscher Ing—March 31, 1900. No. 33557 D.

Otto Gas Engines (Sur les Moteurs à Gaz à Explosion). L. Marchis. Theoretical discussion, with diagram, of the thermodynamics of the gas engines of the Otto type. 500 w. Comptes Rendus—March 12, 1900. No. 33583 D.

The Increasing Use of Large Gas Engines in Modern Power Plants (Ueber die Zunehmende Anwendung von Grossen Gasmotoren in Modernen Kraftbetrieben). H. Münzel. An address delivered before the Cologne branch of the *Verein deutscher Ingenieure*, giving a well illustrated account of the use of gas engines in many

large plants. Two articles. 6000 w. 1 plate. Stahl und Eisen—March 15, April 1, 1900. No. 33543 each D.

The Utilization of Blast Furnace Gases for Generating Electric Power (Die Verwendung der Gichtgase zur Erzeugung Elektrischer Energie). A general account of the use of waste gas from blast furnaces in gas engines. 1600 w. Die Elektrizität—March 17, 1900. No. 33567 C.

Igniters.

Care of Electric Igniters. P. I. Panamolo. Illustrates the usual form of connection employed, and the points needing examination and attention are discussed, and directions given. 1300 w. W Elect'n —April 14, 1900. No. 33677.

Ignition.

Electrical Ignition for Gas and Gasoline Engines. P. P. Nungesser. An explanation of the most successful igniting devices in use at the present time, and the important details requiring attention. 2000 w. Elec Wld & Engr—April 7, 1900. No. 33493.

Thermal Efficiency.

The Efficiency of Steam and Gas Engines. Ed. C. de Segundo. Traces the development of the gas engine, and the limits of its economical use in the past, and refers to recent improvements which have greatly enlarged its usefulness. 2300 w. Jour Gas Lgt—April 3, 1900. No. 33609 A.

STEAM ENGINEERING.

Boilers.

Safety of Boiler Materials (Sicherheit der Kesselbaustoffe). Joh. Trnovskej. A compilation of the so-called "Hamburg" regulations and specifications for securing safety in boiler construction. 3000 w. Oesterr Monatschr f d Oeffent Baudienst —April, 1900. No. 33531 G.

The Boiler Plant on the Champ de Mars (Installation des Chaudières dans les Deux Grandes Usines du Champ-de-Mars). Emile Cayla. A well illustrated general description of the great plant for furnishing steam to the mechanical and electrical sections of the Paris Exposition. 4500 w. 1 plate. Génie Civil—April 7, 1900. No. 33592 D.

Condensation.

Observations on an Improved Glass Revealer, for Studying Condensation in Steam Engine Cylinders and Rendering the Effects Visible. Bryan Donkin. General description with an account of results obtained. Ill. 2000 w. Inst of Mech Engs—Adv. paper. No. 33370 D.

Explosion.

Boiler Explosion in an Iron Works. Illustrated description of the damage done by a water-tube boiler explosion, the path taken by the upper drum, etc. 1200 w. Locomotive—Feb., 1900. No. 33472.

Feed Water.

Boiler Feed Water. J. M. Williams. Paper read before Hamilton Assn., No. 2. C. A. S. E. Discusses water, from the boiler, and in the boiler. 2000 w. Power —April, 1900 w. No. 33353.

Gauges.

Water Gauges. Editorial on the imperfections of the methods in use for determining the level in the boiler. 1800 w. Engr, Lond—March 23, 1900. No. 33398 A.

Indicator.

The Application of the Indicator to the Main and Auxiliary Engines of a Cable Steamer. David Arnot. Diagrams and results collected with as great accuracy as possible. 1600 w. Prac Engr—March 23, 1900. No. 33375 A.

Injectors.

Steam Consumption of Injectors. Strickland L. Kneass. A discussion whether an injector using little or much steam is most economical, inasmuch as the only heat loss that can occur must be the radiation. 1800 w. Loc Engng—May, 1900. No. 33890 C.

Light Engine.

150 H. P. Steam Engine Weighing 1300 Pounds (Machine à Vapeur de 150 Chevaux Effectifs Pèsant 600 Kilogrammes). A brief account of a very light engine built by Boultes and Larbodière, France. 200 w. Revue Technique—March 25, 1900. No. 33850 D.

Pipes.

Steam Pipes. H. de B. Parsons. Discusses the materials, brazing, duplicate system, allowance for expansion, general design, valves, and drips. 4500 w. Stevens Ind—April, 1900. No. 33836 D.

Smoke Consuming.

An Improvement in Smoke Consuming Furnaces. Illustrated description of an invention for supplying atmospheric oxygen to the fire only at the time when smoke is produced. 700 w. Sci Am—March 31, 1900. No. 33363.

Steam Plows.

Cultivation with Steam Plows. J. L. Thompson. Gives an account of experience in Australia and cost of preparing the ground as compared with horses. 1700 w. Am Mfr & Ir Wld—April 12, 1900. No. 33679.

Tension.

The Tension in Cylinder-Head Studs. W. F. Durand. Considers the relation of the initial tension on the stud-bolt due to setting up the nut, to the final resultant stress when the bolts are carrying the steam load. 1100 w. Sib Jour of Engng —April, 1900. No. 33811 C.

Turbines.

The Westinghouse-Parsons Steam Turbines Operating Westinghouse Air-Brake Works. Illustrated detailed description of this plant, where these machines furnish the motive power and lighting. 2800 w. Ir Age—April 12, 1900. No. 33628.

Valves.

Poppet Valves: Their Construction and Calculation. L. Berger. Gives illustrated description of the construction of the valves, and considers the calculations for the springs with the object of obtaining the best performance possible. 1600 w. Horseless Age—April 18, 1900. No. 33742.

MISCELLANY.

Approximate Formulæ.

Approximate Formulæ and their Application in Technical Calculations (Ueber Näherungsgleichungen und deren Anwendung bei Technischen Rechnungen). Dr. J. B. Goebel. Some approximate equations with their applications to hydraulics and safety vales. 800 w. Gesundheits Ing—March 31, 1900. No. 33520 B.

Compressed Air.

The Hydraulic System of Air Compression. Illustrated description of a system in successful operation for two years at Magog, Quebec. 2000 w. Sci Am—April 28, 1900. No. 33828.

An Occurrence of Hydrocarbons in Compressed Air (Ueber ein Vorkommen von Kohlenwasser-stoffen in Druckluft). H. Kette. An account of the formation of explosive gases owing to the volatilization of lubricating oils in an air compressor, near Dortmund, Westphalia. 1500 w. Glückauf—March 17, 1900. No. 33569 B.

Ice Machines.

To Prove Efficiency of Ice Machines Without a Trial Test. J. C. Bertsch. Explains the way to find the work of the machine on the card drawn by the indicator; and tests of ammonia compression machines do not prove efficiency. 3900 w. Ice & Refrig—April, 1900. No. 33352 C.

Invention.

Machinery—Labor-Saving, Labor-Creating or Labor-Killing? Alberta A. Field. An argument against ideas advanced in a work by J. Howard Moore, of Chicago, entitled "Better World Philosophy." 2500 w. Sci Am Sup—April 14, 1900. No. 33682.

Liquid Air.

The Practical Applications of Liquid Air. Carl Linde. Read before the Soc. of German Naturalists and Physicians at Munich. Translated from the *Zeitschr. d Ver Deutscher Ing.* Discusses the possible uses, indicating the limitations. 3000 w. Eng News—April 5, 1900. No. 33454.

Commercial Value of Liquid Air. Alfred Siebert. Gives reasons for its inapplicability for refrigeration and power, considers its cost and refrigerating capacity, etc. 2500 w. Ice & Refrig—May, 1900. No. 33982 C.

Measurements.

Evolution of Standard Measurements. John A. Brashear. On the methods employed in all ages, the legislation, and the birth of the metric and foot rule. 5500 w. Am Mfr & Ir Wld—March 29, 1900. No. 33311.

Ordnance.

Krupp Central Pivot Gravity and Spring-Return Carriages for Naval Ordnance. Illustrates and describes these two ways of mounting guns. 1000 w. Sci Am Sup—March 31, 1900. No. 33371.

Planimeter.

A Simple Explanation of the Construction and Uses of the Planimeter. Cecil H. Peabody. A brief illustrated description of various forms of this instrument, with a simple but complete discussion of its principle. 1500 w. Marine Engng—April, 1900. Serial. 1st part. No. 33479 C.

Refrigeration.

Cold Storage in Toledo. Illustrated description of the Toledo Cold Storage Co.'s ice-making plant, its construction, equipment and capacity. 2000 w. Ice & Refrig—May, 1900. No. 33981 C.

Siege Trains.

A Sketch of the Siege Artillery Train at Camp Rodgers, Tampa, Florida, During the Summer of 1898. E. W. Hubbard. An account of the development of a powerful collection of artillery, with an outline of some of the difficulties met and conquered. 1600 w. Jour U. S. Art—March-April, 1900. No. 33625 D.

Steel Pens.

The Manufacture of Steel Pens (Die Stahlfederfabrikation). P. T. Richter. An address delivered before the *Verein fiir Eisenbahnkunde*, Berlin, giving a full and well illustrated account of the manufacture of steel pens as carried on at the works of Messrs. Heintze and Blanckertz. 8000 w. Glaser's Ann f Gew u Bauw—April 1, 1900. No. 33524 D.

Temperatures.

The Determination of High Temperatures. A. A. Watson. Describes some of the methods of accurately estimating high temperatures, and the scientific principles involved. 2000 w. B C Min Rec—April, 1900. No. 33602 C.

MINING AND METALLURGY

COAL AND COKE.

British Coal.

British Coal Resources. A. D. Provand. Letter to the First Lord of the Treasury calling attention to new facts ascertained since the Royal Commission reported in 1871. 1200 w. Col Guard—March 23, 1900. No. 33385 A.

Checks.

Checks for Sharp Curves on Engine Planes. Idris Thomas, in the *Journal of the British Soc. of Min. Students.* Illustrates and describes a check used at the Caerau Colliery, Maesteg. 350 w. Col Guard—April 6, 1900. No. 33705 A.

Coal Measures.

Identification of an Ohio Coal Measures Horizon in New Mexico. C. L. Herrick and T. A. Bendrat. Calls attention to the remarkable similarity of forms in the measures near Newark, Ohio, and Albuquerque, N. M. 2500 w. Am Geol—April, 1900. No. 33474 D.

Culm Flushing.

Flushing of Culm in Anthracite Coal Mines. William Griffith. Brief general description of the process with illustrations; also discussion of the advantages and of the saving effected. 3000 w. Jour Fr Inst—April, 1900. No. 33342 D.

Gob-Fires.

Gob-Fires. A Review of Some Recent Theories. H. W. Halbaum. Considers their causes and means to prevent or extinguish them. Discusses whether Mr. Stoker's theories are really new and sound. 3000 w. Col Guard—March 23, 1900. No. 33386 A.

Missouri.

Mine No. 15, Rich Hill, Missouri. Charles Evans. A description of its equipment, including a new electric haulage plant, by which the output has been increased. 1000 w. Mines & Min—April, 1900. No. 33433 C.

Outcrops.

Dangerous Outcrops under Quicksand Deposits. G. M. Williams. Illustrates and describes a formation found in the ancient river bed of the Wyoming coal basin, which has caused great trouble and expense in mining. 3800 w. Mines & Min—April, 1900. No. 33432 C.

Rontgen Tests.

Testing Coal by Means of Röntgen Rays (Untersuchung von Kohlen mittels Röntgenstrahlen). F. Kotte. Short account, with good illustrations, of Röntgen ray tests of powdered coal. 400 w. Stahl und Eisen—April 4, 1900. No. 33-545 D.

Russia.

The Coal Crisis in Russia and the Main Sources of Native Supply. H. Cooke. A Foreign Office report. Discusses the present scarcity and high price of coal, and the causes, and remedies. 2500 w. Col Guard—March 23, 1900. No. 33387 A.

Strikes.

Coal Strikes and Miners' Wages in Austria. An account of a determined contest between capital and labor, now going on in the northern provinces. 800 w. U. S. Cons Repts, No. 704—April 14, 1900. No. 33651 D.

Surface Arrangements.

Colliery Surface Arrangements. Ernest H. Thomas. A Lewis prize essay, 1899, printed in the Pro. of the So. Wales Inst. of Engs. Illustrated description of some of the recent improvements for the delivery of coal from the pit cage to the railway wagon. 5500 w. Col Guard—March 30, 1900. No. 33620 A.

Colliery Surface Arrangements. S. A. Everett. A Lewis prize essay. Printed in Pro. of the So. Wales Inst. of Engs. (First Prize.) Describes typical conditions and the method of handling coal with as little breakage as possible, sorting and cleaning with minimum labor. Ill. 7000 w. Col Guard—April 6, 1900. No. 33706 A.

Washing.

New Coal-Washing Plant at the Cadeby Colliery. Illustrated detailed description. 1800 w. Ir & Coal Trades Rev—March 23, 1900. No. 33382 A.

Rapid Coal Tests and Check on Coal Washing. M. Maurice. Describes the method used by the writer, his manner of operating, and of determining the water constant, composition of the shale and coal, and perhaps the ash content. 3800 w. Col Guard—April 6, 1900. No. 33707 A.

Weighing.

Automatic Coal-Weighing and Recording Machines. Charles Ingrey. Abstract of paper read at meeting of the Cleveland Inst. of Engs. The writer's views of what should constitute a perfect automatic coal-weighing and recording machine, describing one designed by himself, which he claimed fulfilled these conditions. 3000 w. Col Guard—April 6, 1900. No. 33703 A.

COPPER.

Butte.

The Mines of Butte. Arthur Lakes.

An illustrated description of the great concentrating and smelting plants, enormous hoisting machinery, the extensive ore body, and various devices by which the great copper output is obtained. 3000 w. Mines & Min—April, 1900. No. 33428 C.

Mexico.

Copper Mining at Placeritas de Nacosari, Sonora, Mexico. H. B. Layton. Illustrated detailed account of the mines and works of the Montezuma Copper Co. 4000 w. Min & Sci Pr—March 31, 1900. No. 33406.

New Jersey.

Schuyler Copper Mines. An abandoned copper property which is to be reopened and developed by modern methods. 800 w. Mines & Min—April, 1900. No. 33437 C.

Ore.

Something About Copper Ore. Albert R. Ledoux. Extract from a lecture delivered before the N. Y. Elec. Soc. An account of the deposits and the steps through which the ore passes. 1200 w. Am Mfr & Ir Wld—April 26, 1900. No. 33894.

Panuco.

The Panuco Copper Mine Deal. An account of a mine in Mexico, floated by a London company, which has proved of little value. 1200 w. Eng & Min Jour—April 21, 1900. No. 33748.

Refining.

Copper from the Ore to the Wire Bar. Albert R. Ledoux. Synopsis of a lecture before the N. Y. Elec Soc. Describes the deposits, the furnaces and various steps in detail. 3200 w. Elec Rev, N. Y.—April 11, 1900. No. 33631.

Supply.

The World's Copper Supply. H. J. Stevens. A review of the copper industry. 1500 w. Mines & Min—April, 1900. No. 33431 C.

Yukon.

Yukon Territory—Lewis River Copper District. W. M. Brewer. Brief description of this district. 500 w. Eng & Min Jour—March 31, 1900. No. 33358.

GOLD AND SILVER.

Amalgamation.

Amalgamation of Metals, Normal and Electrolytic. J. H. Jory. Presents facts concerning amalgamation and the value of electrolytic amalgamation. 2000 w. Min & Sci Pr—April 21, 1900. No. 33816.

Assaying.

Losses in the Determination of Gold and Silver in Copper Bullion, Their Causes, and a Method for Overcoming Them. W. Randolph Van Liew. 2000 w. Eng & Min Jour—April 21, 1900. Serial. 1st part. No. 33752.

Bokhara.

The Gold-Bearing Conglomerates of Bokhara. Information from a lecture delivered before the Royal Geog. Soc. in London, by W. Rickmers. 800 w. Eng & Min Jour—April 21, 1900. No. 33750.

British Columbia.

Vancouver Island—Alberni District William M. Brewer. An illustrated description of this property, which is the most thoroughly developed on the island, having been opened to a depth of 350 ft. 1900 w. Eng & Min Jour—April 21, 1900. No. 33749.

West Kootenay Mining District—Rossland. William M. Brewer. A report of recent work in this district, changes in management, etc. 1000 w. Eng & Min Jour—April 7, 1900. No. 33439.

Colorado.

Mineral Resources of Colorado. G. Frank Judson. Part first begins a review of the Cripple Creek district. Ill. 2500 w. Min Rept—April 12, 1900. Serial. 1st part. No. 33696.

The Lamartine Mine at Idaho Springs, Colorado. Arthur Lakes. An illustrated account of a celebrated gold and silver mine with a difficult drainage problem. 3000 w. Mines & Min—April, 1900. No. 33427 C.

Concentrator.

The New Peck-Montana Concentrator. George W. Winter. Illustrated description of the Peck concentrator at the Peck-Montana mill. 1300 w. Eng & Min Jour—March 31, 1900. No. 33357.

Cyanide.

Some Observations on Practice of the Cyanide Process at Mercur, Utah. William Magenau. A classification of the ores based on the mode of treatment is given, with outline and notes concerning the treatment of the oxidized ore. 2500 w. Min & Sci Pr—April 21, 1900. Serial. 1st part. No. 33818.

Dredging.

Gold Dredging in New Zealand. Illustrated description of one of the largest dredges used, and its operation, with information concerning cost and working. 1800 w. Engng—April 13, 1900. No. 33776 A.

Gold Dredging in Borneo. An interesting interview with T. R. Toby, who has been recently on an exploring and prospecting trip in West Borneo. Considers the country sure to become a great gold producer. Ill. 2400 w. Aust Min Stand—March 15, 1900. No. 33832 B.

Gold-Dredging in New Zealand. Victoria and New South Wales. George

Robson. Information concerning the process, with general discussion. 2800 w. N Z Mines Rec—Jan. 16, 1900. No. 33488 B.

Lixiviation.

The Lixiviation of Gold Deposits by Vegetation. Emil E. Lungwitz. Discusses this subject, giving report of personal experiments. 3000 w. Eng & Min Jour—April 28, 1900. No. 33786.

Mexico.

The Batopilas Mines, Mexico. Abstract of the general manager's report showing the present condition and prospects. Also editorial. 3800 w. Eng & Min Jour—April 14, 1900. No. 33668.

New Zealand.

New Zealand's First Mining Speculation. Ro. Carrick. Narrates incidents in the discovery and early development of mining in New Zealand. 1400 w. N Z Mines Rec—Jan. 16, 1900. No. 33489 B.

Pacific Coast.

Beach Sands of the Pacific Coast. W. J. Adams. Discusses their origin, methods of working, devices used, etc. Ill. 4500 w. Mod Mach—April, 1900. No. 33373.

Placers.

Southern Oregon Placer Conditions. Theo. F. Van Wagenen. Interesting information relating to this region. 1300 w. Min & Sci Pr—April 21, 1900. No. 33817.

The Placer Fields of Custer County, Idaho. C. C. Clawson. History of the work in this locality, and the recent revival of mining. 1700 w. Eng & Min Jour—April 14, 1900. No. 33669.

Prospecting.

Cost of Prospecting by Drilling in Joplin District. Harold A. Titcomb. Describes the method employed, giving report of cost, which is largely dependent on the speed. 1000 w. Eng & Min Jour—April 7, 1900. No. 33438.

Prospectors' Mistakes. The first of a series of articles on this subject. 1000 w. Min & Sci Pr—March 31, 1900. Serial. 1st part. No. 33407.

Sluicing.

Hydraulic Sluicing in the Collingwood District. H. F. Logan. Descriptive. 2400 w. N Z Mines Rec—Feb. 16, 1900. No. 33490 B.

Transvaal.

Transvaal Gold Mines (Mines d'Or du Transvaal). Extracts from the reports of the engineers in charge of some of the mines which are being temporarily worked by the Transvaal government, up to the end of 1899. 1500 w. Moniteur Industriel—March 17, 1900. No. 33595 E.

IRON AND STEEL.

American Works.

Novelties in American Steel Works (Neuerungen bei Amerikanischen Stahlwerken). H. Staunnschulte. An address delivered before the *Eisenhütte Oberschlesien*, giving an illustrated description of new improvements in various American steel plants. 2200 w. Stahl und Eisen—April 1, 1900. No. 33544 D.

Armor Plate.

Armor Plate Manufacture in Germany. Brief consideration of the effect upon this industry of the scheme for increasing the German navy. 1200 w. Engr, Lond—April 13, 1900. No. 33781 A.

Armor Plates. A review of progress in the manufacture in the different countries. 2500 w. Engng—April 6, 1900. No. 33698 A.

Some Notes on the Development of Armor for Naval Purposes. Discusses the various forms and qualities of armor, and the cost at which it has been supplied at different periods. 4700 w. Ir & Coal Trds Rev—April 13, 1900. No. 33800 A.

Blast Furnaces.

Utilizing the Heat of Molten Slag. Herbert Lang. A letter discussing Mr. Bretherton's invention and the subject in general. 2800 w. Eng & Min Jour—April 28, 1900. No. 33838.

Crucible Steel.

Crucible Steel (Tiegelstahl). O. Thallner. A paper read before the Upper Silesian branch of the *Verein Deutscher Ingenieure*, giving an account, with table and curves, of crucible steel and its manufacture at the Bismarck works, in Silesia. 2200 w. Zeitschr d Ver Deutscher Ing—March 31, 1900. No. 33561 D.

Furnace.

Ingot Heating Furnace. Specification, with illustrations of a new heating furnace, designed to heat cast-steel ingots. 1200 w. Am Mfr & Ir Wld—April 5, 1900. No. 33483.

Tipping Furnace for Combined Martin and Bessemer Process. P. Eyermann, in *Stahl und Eisen*. Describes a new method of regenerating crude iron, giving illustration of the furnace. 2000 w. Col Guard—March 30, 1900. No. 33619 A.

Japan.

The Manufacture of Iron in the East. B. H. Thwaite. Detailed description of the new Japanese Government Iron and Steel Works. 2000 w. Ind & East Engr—March, 1900. No. 33652 D.

Labrador.

The Iron Ores of the Labrador Peninsula. A. P. Low. An interesting illustrated account of a personal examination of some yet unworked deposits, describing the oc-

currence, character, and analysis of the ores and the general facilities of the region. Ill. 2200 w. The Engineering Magazine—May, 1900. No. 33903 B.

Lake Superior.

The Lake Superior District in 1900. Waldon Fawcett. Some of the conditions tending to increase the production of iron ore. Preparations for haulage, storage and loading. Ill. 1500 w. Am Mfr & Ir Wld—April 5, 1900. No. 33482.

Martin Furnaces.

Tipping Martin Furnaces (Zur Frage der Kippbaren Martinöfen). P. Eyermann. An illustrated account of improvements in the details of the Martin basic steel process. 2000 w. Stahl und Eisen—March 15, 1900. No. 33542 D.

Newfoundland.

The Wabana Iron-Ore Mines. H. B. C. Nitze. Illustrates and describes rich deposits on the island of Newfoundland which are mined by open quarries close to deep-water shipping facilities. 1000 w. Mines & Min—April, 1900. No. 33-434 C.

Norway.

Iron Ore Deposits of Dunderland, Norway. H. L. Geissel. Brief account of rich deposits of great extent. 700 w. Eng News—April 26, 1900. No. 33825.

Otto's Process.

A New Direct Process. Briefly reviews various methods that have been tried, and describes the process patented by Carl Otto for the direct production of iron and steel, with critical comment. Ill. 2800 w. Ir & Coal Trds Rev—April 13, 1900. No. 33801 A.

Steel Makers.

The Great Steel Makers of Pittsburg and the Frick-Carnegie Suit. Julius Moritzen. An explanation of the suit, with review of Mr. Carnegie's career, and also of the life of H. C. Frick, giving a brief account of the company. Ill. 6500 w. Rev of Revs—April, 1900. No. 33-350 C.

West Africa.

The Native Iron Industry in German West Africa. F. Hupfeld, in *Stahl und Eisen*. Describes the manner of working, the location of deposits, etc. 1300 w. Col Guard—March 30, 1900. No. 33-622 A.

MINING.

Accidents.

Compilation of the Fatal and Disabling Accidents in the Breslau Mining District, Germany (Zusammenstellung der im Jahre, 1899, im Oberbergamtsbezirke Breslau beim Bergwerksbetriebe Vorgekommenen Tödtlichen Verunglückungen). A list of the accidents to miners which were fatal, and those which disabled for four weeks or more. 200 w. Glückauf—April 7, 1900. No. 33574 B.

Belgium.

Mining and Metallurgy in Belgium During 1898 and the First Half of 1899 (Bergwerks und Hüttenbetrieb in Belgien im Jahre, 1898, und im I. Semester 1899). A short article taken from the *Annales des Mines de Belgique*, giving tables showing the production of mines, accidents, etc. 400 w. Oesterr Zeitschr f Berg u Hüttenwesen—March 17, 1900. No. 33535 B.

Camps.

Mining Camps of the Northwest. Arthur Lakes. A sketch of some of the leading camps in Northern Washington, Idaho, Oregon, and British Columbia. 2800 w. Mines & Min—April, 1900. No. 33436 C.

Electric Machinery.

See Electrical Engineering, Power Application.

Errors.

Mining Errors. F. Danvers Power. Read before the New South Wales Chamber of Mines. Discusses prospectus writing, promoters, directors, mine management, and experts. 2500 w. Ir & Coal Trds Rev—March 30, 1900. No. 33624 A.

Explosives.

Modern Explosives. J. S. S. Brame. A lecture delivered at the London Inst. A discussion of such explosives as are most used in modern warfare. 4000 w. Nature—April 5, 1900. No. 33687 A.

The Question of Underground Magazines for Explosives (Zur Frage der Unterirdischen Sprengstoff Magazine). Franz Prispisil. A paper before the *Berg-und Hüttenmännischen Vereines* in Ostrawa, Moravia, with various tables. Two articles. 4500 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen—March 17, 24, 1900. No. 33534 each B.

The Theory of Safety Explosives (Zur Theorie der Sicherheitssprengstoffe). H. Heise. An abstract of an essay by the Austrian General Hess on substances which explode so rapidly that the surrounding atmosphere has not time to take up the shock and so is compressed and raised to a dangerous temperature. 1400 w. 1 plate. Glückauf—March 24, 1900. No. 33570 B.

Fans.

Fan Volume Recorder. M. Murgue. Illustrated description of apparatus for recording the volume of air delivered and the method of using it. 3200 w. Col Guard—April 12, 1900. No. 33783 A.

Fuses.

The Evolution of Safe and Accurate

Fuse Protective Devices. Joseph Sachs. An illustrated description of the enclosed fuse and discussion of the principles on which it is based and operates. General discussion. 15000 w. Trans Am Inst of Elec Engs—Feb., 1900. No. 33475 D.

Hand Drill.

Improved Heise Hand Drills (Verbesserungen der Heiseschen Handbohrmaschine). A short account, calling attention to improvements. 600 w. 1 plate. Glückauf—April 1, 1900. No. 33571 B.

Inclines.

The Safety Aspect of Inclines. Henri Ghysen. From a communication to the Charleroi Section of the Assn. des Ingenieurs de Liege. Considers the pulley with its brake, and the fence closing the incline, describing arrangements for safety. Ill. 2800 w. Col Guard—March 30, 1900. No. 33621 A.

Quarrying.

The Quarrying Industry in France. Arthur Lee. Interesting account of the quarries and their products, the amount of labor employed, etc. Ill. 3000 w. Stone—April, 1900. No. 33637 C.

Shafts.

A New Method of Shaft Sinking. G. C. McFarlane. Illustrates and describes a method of sinking when it is necessary to go through water bearing strata. 800 w. Eng & Min Jour—April 7, 1900. No. 33442.

Boring a Pair of Shafts Through Heavily-Watered Measures. M. L. Petit. From a communication to the Société des Ingénièurs des Mines du Hainaut. Illustrates and describes a difficult piece of mining work. The shafts were passed through heavily-watered measures and quicksands. 4800 w. Col Guard—March 23, 1900. No. 33384 A.

Shifts.

The Length of Shifts in the Ostrawa-Karwin Coal District (Ueber die Schichtdauer im Ostran-Karwiner Kohlenrevier). Max von Gutmann. Paper before the Austrian *Ingenieur-und Architekten-Vereines*, giving a full discussion of the subject of the hours of labor in coal mines, with many tables. Two articles. 6000 w. 2 plates. Oesterr Zeitschr f Berg u Hüttenwesen—March 24, 31, 1900. No. 33536 each B.

Surveys.

Surveys in Inclined Shafts. Joseph Barrell. Theoretical and practical considerations governing the choice of instruments. 2700 w. Mines & Min—April, 1900. No. 33435 C.

Underground Surveys and Their Connection with the Surface by the Transit Method. E. H. Liveing. Read before the Midland Inst. of Min., Civ., & Mech. Engs., at Leeds, Eng. Particulars from the writer's experience in the use of this method. Ill. 2500 w. Prac Engr—March 23, 1900. No. 33376 A.

Unwatering.

Balancing Boilers for Unwatering Mines. William Kelly. Illustration and description of method. 900 w. Eng & Min Jour—April 14, 1900. No. 33670.

Wages.

The Wages of Miners in Prussia in 1899 (Die Bergarbeiterlöhne im IV. Vierteljahre, sowie im Ganzen Jahre 1899). Tables published in the *Reichsanzeiger*, giving wages statistics for the various mining industries. 1000 w. Glückauf—March 17, 1900. No. 33575 B.

Winding.

Combined Safety Clutch and Stopping Device for Winding Cages. O. Schenck, in *Allgemeine bergmannische Zeitschrift*. Illustrated detailed description. 800 w. Col Guard—April 12, 1900. No. 33784 A.

Fowler's Hydraulic Decking Arrangement. Illustrates and describes the arrangement in use at Cinder Hill Colliery, Nottingham. It was invented to save the time taken up in changing the decks of the winding cages. 1600 w. Ir & Coal Trds Rev—March 23, 1900. No. 33383 A.

MISCELLANY.

Aluminum.

The Progress of Aluminum. A review of the position and prospects, and general information. 4500 w. Engr, Lond—March 23, 1900. No. 33393 A.

The Relations of Aluminum to Iron. Godfrey Melland. Abstract of a paper read before the So. Staffordshire Ir. and Steel Inst. Reviews facts ascertained, considering the alloys, and the use of aluminum in the treatment of malleable and cast iron. 2000 w. Ir & Coal Trds Rev—March 30, 1900. No. 33623 A.

Asbestos.

Asbestos. A. Selwyn Brown. Describes this peculiar mineral and gives interesting information concerning the locations of deposits, the production, uses, etc. 2000 w. Aust Min Stand—March 1, 1900. No. 33601 B.

The Asbestos Mines at Thetford, Canada. L. P. Gratacap. Illustrates and describes the deposits and their workings, with information concerning the value, uses, etc. 1100 w. Sci Am—April 7, 1900. No. 33408.

Assaying.

Nickel and Cobalt Assaying. M. E. D. Merry. Describes a speedy and accurate method in use for about fifty years, and never before published. 1500 w. B. C. Min Rec—April, 1900. No. 33603 C.

Diamonds.

A Big Diamond Deal. W. S. Dowel. An account of the De Beers purchase, and the cashing of a check for £5,338,650. 1200 w. Aust Min Stand—March 1, 1900. No. 33600 B.

Ecuador.

Minerals and Mining in Ecuador. Facts furnished by a French metallurgist who is regarded as an authority. 1700 w. U. S. Cons Repts, No. 694—April 3, 1900. No. 33368 D.

Fuller's Earth.

Fuller's Earth. J. Ohly. Describes the manner of formation, the uses to which it is applied, the deposits, etc. 2500 w. Min Rept—March 29, 1900. No. 33399.

Germany.

The Mining Products of Germany and Luxemburg for 1899 (Die Gewinnung der Bergwerke, Salinen und Hütten im Deutschen Reich und in Luxemburg während des Jahres, 1899). Preliminary official report, giving tables of both raw and manufactured mineral products, both as to weight and market value. 500 w. Glückauf—April 7, 1900. No. 33573 B.

Graphite.

The Occurrence, Treatment and Application of Graphite. W. F. Downs. Part first is introductory to a series of articles which will treat of the occurrence, gradation, preparation and application. 700 w. Ir Age—April 19, 1900. Serial. 1st part. No. 33714.

Hydrocarbons.

The Hydrocarbons of Eastern Utah. Don Maguire. With special reference to the deposits of ozokerite, gilsonite, and elaterite. Their properties, and the uses to which they are adapted. The forms of the deposits, their situation, and the extent to which they have been prospected and developed. 2800 w. Mines & Min—April, 1900. No. 33429 C.

Mexico.

The Avino Mine, Mexico. An illustrated description of a modern plant which takes the place of a primitive one at one of the oldest mines in Mexico. 1500 w. Mines & Min—April, 1900. No. 33430 C.

Museum.

The Egleston Mineralogical Museum of Columbia University. Alfred J. Moses. An account of this museum, its collections, classification, etc. 1600 w. Eng & Min Jour—April 7, 1900. No. 33440.

Nitric Acid.

Lyte and Lunge's Nitric Acid Process. Julius L. F. Vogel. Describes an improved process which leaves the soda portion in its most valuable form, and in which there is no waste product. Ill. 2200 w. Eng & Min Jour—April 7, 1900. No. 33441.

Petroleum.

The Russian Petroleum Trade. An account of the production, consumption, cost, extension of territory, etc., with statistics of trade. 5000 w. U. S. Cons Repts, No. 706—April 17, 1900. No. 33685 D.

Scrip and the Law of Title to Oil Lands. A. H. Ricketts. An explanation of the term "scrip" and the names by which it is known are given in part first. 2500 w. Min & Sci Pr—April 7, 1900. Serial. 1st part. No. 33641.

Philippines.

Some of the Resources of the Philippines. G. D. Rice. An account of the minerals and methods of mining, native labor, etc. 1700 w. Eng & Min Jour—April 14, 1900. No. 33667.

Tin.

Greenbushes Tin-Field. Information concerning the situation and the character of these deposits, which are known to contain deleterious impurities, difficult to eliminate. 2200 w. Aust Min Stand—March 15, 1900. No. 33833 B.

Turquoise.

The Turquoise Mines of Persia. H. L. Geissel. An account of the only mines producing this stone, and of the primitive method of mining. 1100 w. Sci Am—April 21, 1900. No. 33715.

Zinc.

Zinc Deposits. C. C. Longridge. A tabular statement illustrating the geological distribution of zinc ores, with interesting information. 1000 w. Engr, Lond—April 6, 1900. No. 33711 A.

RAILWAY AFFAIRS

CONDUCTING TRANSPORTATION.

Accidents.

Train Accidents in the United States in February. Detailed list and classified summary. 3500 w. R R Gaz—April 6, 1900. No. 33463.

Train Accidents in the United States in March. Detailed list and classified summary, with comments. 3500 w. R R Gaz—April 27, 1900. No. 33842.

Boarding Moving Trains.

The Taking Up of Passengers and Bag-

gage by Moving Trains (Die Uebernahme von Personen und Gepäck durch Fahrende Bahnzüge). An illustrated account of a system recently patented at Berlin, by which a motor car is to accompany moving trains for a short stretch at stations and transfer passengers and freight. 700 w. Oesterr Monatschr f d Oeffent Baudienst—April, 1900. No. 33533 G.

Double Heading.

Double Heading. C. B. Conger. Discussion of this practice, which has become common in these days of heavy trains. 1600 w. Loc Engng—May, 1900. No. 33887 C.

Fighting Snow.

Fighting Snow in Alaska. An illustrated account of the difficulties encountered in operating trains on the White Pass & Yukon Ry. 500 w. Ry & Engng Rev—April 7, 1900. No. 33497.

Pennsylvania R. R.

Organization of the Pennsylvania Railroad. Diagram, showing in graphic form the official relations of all the general officers and heads of departments. 400 w. R R Gaz—April 27, 1900. No. 33841.

FINANCIAL.

Air Line.

The Greater Seaboard Air Line System. An account of the project to consolidate several railroads into a system known by this name. Map. 1000 w. R R Gaz—April 6, 1900. No. 33461.

Denmark.

General Operating Statistics of the Denmark State Railroads for 1897 and 1898 (Danemark, Résultats Généraux de l'Exploitation des Chemins d Fer de l'Etat pendant les Exercises Terminés aux 31 Mars, 1898 et 1897). Five short tables giving general movement and expense statistics, taken from the Danish official reports. 100 w. Ann d Ponts et Chaussées—Jan., 1900. No. 33581 E + F.

Queensland.

The Railways and Trade of Queensland. Editorial discussion of the general results of the railway operations of the past year. 2300 w. Engng—March 23, 1900. No. 33392 A.

General Operating Statistics of the Queensland, Australia, Railroads for 1897-98 and 1896-7 (Australie, Province de Queensland. Résultats Généraux de l'Exploitation des Chemins de Fer pendants les Exercises 1897-8 et 1896-7). Five short tables giving general movement and expense statistics, taken from the report of the Queensland Railway Commissioner. 100 w. Ann d Ponts et Chaussées—Jan., 1900. No. 33580 E + F.

Roumania.

General Operating Statistics of the Roumanian State Railroads for 1896 and 1897 (Roumanie. Résultats Généraux de l'Exploitation des Chemins de Fer de l'Etat pendant les Années 1897 et 1896). Five short tables giving general movement and expense statistics, taken from Volume 48 of the *Statistique de l'Union des Administrations des Chemins de Fer Allemands.* 100 w. Ann de Ponts et Chaussées—Jan., 1900. No. 33582 E + F.

LEGAL.

Safety Appliances.

Safety Appliances in Mexico. Translation of the order issued by the Mexican Government requiring railroads to equip their cars with certain safety appliances. 600 w. R R Gaz—April 20, 1900. No. 33757.

MOTIVE POWER AND EQUIPMENT.

Air-Brakes.

Tests of Air-Braked Trains on Mountain Grades. Extracts from the report published by the Westinghouse Air Brake Company, as "Bulletin No. 7," containing important information. 3000 w. R R Gaz—April 27, 1900. No. 33840.

Bearings.

The Improved Susemihl Roller Side Bearing. Illustrated description of these roller side bearings, in use on the Michigan Central R. R. 900 w. R R Gaz—April 6, 1900. No. 33462.

Cars.

70,000 Lbs. Capacity Cars for the Philadelphia & Reading Railway. Illustrated detailed description. 1200 w. R R Gaz—April 27, 1900. No. 33845.

Coal Cars.

80,000-Pound Steel-Frame Coal Cars with Drop Doors. Illustrated description of cars for the Norfolk & Western Ry., having frames of structural steel with wooden floors and siding. 800 w. Am Engr & R R Jour—April, 1900. No. 33315 C.

Compounds.

Blows in Baldwin Compounds. Alonzo B. Kinyon. Illustrates and describes action of the Vauclain compound locomotive and explains the cause of blows and the remedy. 1500 w. Loc Engng—April, 1900. No. 33329 C.

Fuel.

Burning Oil on Locomotives. C. R. Petrie. Illustrated description of apparatus and method employed on Southern Pacific locomotives. 800 w. Loc Engng—April, 1900. No. 33330 C.

Hand Brakes.

The Efficiency of Hand Brakes on Railway Cars (Ueber den Wirkungsgrad

der Spindelbremsen von Eisenbahn-Fahrzeugen). C. Schlöss. An illustrated account of careful tests made on the Austro-Hungarian Railroads. 1600 w. Zeitschr d Oest Ing u Arch Ver—April 6, 1900. No. 33551 B.

Hot Box.

Some Causes of Hot Bearings with a New Form of Brasses for Railroad Car Journals (Ueber einige Ursachen des Heisslaufens der Lager und über eine Neue Lagerschale für Eisenbahnfahrzeuge). Josef Grossmann. Discussion of the causes of hot journals, with suggestions for diminishing them. 4500 w. Zeitschr d Oesterr Ing u Arch Ver—March 23, 1900. No. 33549 B.

Locomotives.

Brooks Consolidated Locomotives, L. S. & M. S. Ry. Illustration of engine for freight service, with general dimensions. 900 w. Ry & Engng Rev—April 21, 1900. No. 33789.

Consolidation Locomotives for the Oregon Short Line. Illustrated description, with dimensions. 500 w. R R Gaz—April 20, 1900. No. 33755.

Eight-Wheel Passenger Locomotive—Boston & Albany R. R. Engraving general dimensions and remarks. 600 w. Am Engr & R R Jour—April, 1900. No. 33318 C.

Eight-Wheel Passenger Locomotives for the New York, Ontario & Western Railway. These engines have a deep, narrow fire box designed for burning bituminous coal. Dimensions and description. 700 w. R R Gaz—April 20, 1900. No. 33756.

Freight Locomotive; East Indian Ry. Dimensions, illustration and description of an English built engine. 1000 w. Eng News—April 12, 1900. No. 33645.

Locomotive Design. E. H. McHenry. Chart of locomotive horse-power, with discussion of the curves of various engines. 1700 w. R R Gaz—April 13, 1900. No. 33646.

Schenectady Mogul Locomotive, N. Y. C. & H. R. Ry. Illustration and views showing the points of interest of these new freight engines, with particulars. 900 w. Ry & Engng Rev—March 31, 1900. No. 33361.

The Colliery Locomotive. An illustrated review of the early history of the locomotive engine, which was inseparably connected with colleries. 2200 w. Ir & Coal Trds Rev—April 6, 1900. Serial. 1st part. No. 33709 A.

Mineral Locomotives for the Port Talbot and Barry Railways. Engravings showing the details of the design, and the general arrangement, with description. 1000 w. Engng—April 13, 1900. No. 33773 A.

Norfolk & Western Freight Engines. Illustrated detailed description of the new piston valves used. They were designed by W. H. Lewis and are entirely satisfactory. 400 w. Loc Engng—May, 1900. No. 33885 C.

Prairie Type and Wide Firebox Switch Engines. Illustrated description of new types for service on the C. B. & Q. R. R. The Prairie type is regarded as an epoch-making design which will show the possibilities of a moderate widening of grates. The switch engine is believed to be the first wide firebox built for the use of soft coal. 1700 w. Am Engr & R R Jour—April, 1900. No. 33316 C.

Cast Steel Parts of the New Chicago and Alton Eight-Wheel Locomotives. Reproduced drawings and table showing the finished weights of the steel-castings used, and also the weights of similar parts in wrought iron or cast iron. 500 w. R R Gaz—April 20, 1900. No. 33754.

Nozzles.

Why Not Try Variable Nozzles? Editorial discussing the advantage of using variable nozzles. 900 w. Loc Engng—April, 1900. No. 33331 C.

Smoke.

Burning Bituminous Coal Without Smoke on the Southern Pacific System. J. Snowden Bell furnishes notes concerning the results obtained by the methods in use. Detail drawings of the mechanical features contributing to the results are given. 1800 w. R R Gaz—April 27, 1900. No. 33844.

NEW PROJECTS.

Africa.

The Railways of Africa. H. L. Geissel. Describes the railways constructed and under construction, giving information relating to them. 4000 w. Ry Age—April 6, 1900. No. 33406.

China.

Railway Opportunities in the Orient. Wm. Barclay Parsons. Considers India and Japan as prophetic of the future of China, and shows by the profitable returns from railways worked in those countries what large opportunities are opening in China. Ill. 2700 w. The Engineering Magazine—May, 1900. No. 33902 B.

Extension.

Construction of the Mississippi River Extension of the Chicago & Eastern Illinois R. R. Illustrated description of this work, its viaducts, etc. The distance is 62 miles. 1500 w. Eng News—April 12, 1900. No. 33642.

Great Central Ry.

Completing the Great Central Railway. Reviews the work that has been accomplished during the last year in completing the extension opened. 1400 w. Engr, Lond—March 23, 1900. No. 33395 A.

The Great Central Railway Extension. Abstracts of two papers on this subject, read at meeting of the Brit. Inst. of Civ. Engs. F. W. Bidder's paper referred to the line from Annesley to Rugby. F. Douglas Fox described the line from Rugby to the London terminus. 2200 w. Col Guard—April 6, 1900. No. 33708 A.

Russia.

Russian Railways. H. L. Geissel. A. review of progress made and projects contemplated. 1500 w. Ry Age—April 13, 1900. No. 33672.

Sahara.

The Trans-Sahara Railroad (Le Transsaharien). G. Leugny. A general sketch, with maps of this proposed railroad from Algiers to Lake Tchad and other points in French Africa. 3000 w. Revue Technique—March 10, 1900. No. 33598 D.

Trans-Siberian.

The Trans-Siberian Railway. Information from a recent "Guide to the Siberian Railway," issued by the Russian Imperial Ministry of Ways of Communication. Shows the importance of the line, the unexpected traffic, and the great wealth of the country. 1600 w. Engr, Lond—April 6, 1900. No. 33713 A.

PERMANENT WAY AND FIXTURES.

Engine Houses.

The New Engine Houses of the Swiss North Eastern Railroad at Zurich (Die Neue Locomotiv-Remisenanlage der Schweiz. Nordostbahn in Zürich). E. Egger. An illustrated account of this locomotive house and repair shop. 1600 w. Schweiz Bauzeitung—April 7, 1900. No. 33539 B.

Painting.

Painting Railroad Bridges. Hunter McDonald. Extracts from a paper before the Engng. Assn. of the South. Describes a recent laboratory test of twenty different kinds of paint made recently by the writer. 1300 w. R R Gaz—April 27, 1900. No. 33839.

Rail Tests.

Do the Usual Acceptance Tests of Steel Rails Answer Their Purpose (Eutspricht das zur Zeit Uebliche Prüfungsverfahren bei der Uebernahme von Stahlschienen seinem Zwecke)? A. Martens. Based on articles in *Baumaterialenkunde*. A long article, with illustrations and tables, criticising existing methods, and suggesting improvements. Two articles, 8000 w. 1 plate. Stahl und Eisen—March 15, April 1, 1900. No. 33541 each D.

Shops.

Cleburne Shops of the Santa Fé. Description of large shops recently erected for locomotive and car repairs. 1200 w. Loc Engng—April, 1900. No. 33328 C.

Shops of the Mexican Central at Aguas Calientes. Plan and description of the plant, with remarks. 1500 w. R R Gaz—April 6, 1900. No. 33458.

Through Siberian Railroad Shops. L. Lodian. An illustrated description of the shops, machinery, and stations of the Trans-Siberian Ry. 3000 w. Loc Engng—May, 1900. No. 33888 C.

Signals.

Calling-on Signals at Savanna, Ill. Illustrates and describes how this signal, on C., M., & St. P. Ry., is used. 350 w. R R Gaz—April 13, 1900. No. 33647.

Extra Block-Signal Safe Guards in Time of Fog. Editorial discussing English methods, and suggesting methods of protecting trains during fog. 1300 w. R R Gaz—April 20, 1900. No. 33760.

Visibility and Confusion Tests of Signal Glasses. Brief account of interesting experiments made by Prof. Louis Derr with colored glasses for fixed signals. 700 w. R R Gaz—April 6, 1900. No. 33457.

Maintenance and Inspection of Automatic Electric Block Signals. H. S. Balliet. Read at meeting of the Ry. Sig. Club, Chicago. Describes the system and the maintenance force necessary for its efficient operation. 1600 w. Ry Age—April 6, 1900. No. 33495.

Switch and Signal.

New Signal and Safety Switches on the Prussian Railroads (Neuerungen an den Signal-Weichensicherungsanlagen auf den Preussischen Eisenbahnen). H. Scholkmann. An address delivered before the *Verein für Eisenbahnkunde*, Berlin, giving an account of recent improvements in safety appliances on the Prussian railways. Well illustrated. 4500 w. Glaser's Ann f Gew u Bauw—March 15, 1900. No. 33522 D.

Ties.

New Tie Treating Plant of the Burlington & Missouri River Railroad. Illustrates and describes the plant at Edgemont, S. D., where an average of 50,000 ties a month are treated. 700 w. R R Gaz—April 6, 1900. No. 33460.

Tie Preserving Plant, B. & M. R. Ry., Edgemont, S. Dak. Illustrates and describes a plant where the zinc-chloride process is used. Also editorial. 1500 w. Ry & Engng Rev—March 31, 1900. No. 33362.

Tie Treating. O. Chanute. Reviews briefly the history of the preservation of crossties by the injection of chemical substances. 1100 w. R R Gaz—April 6, 1900. No. 33456.

Treating Railroad Ties and Timber. A description of the method and apparatus

used on the Atchison, Topeka & Santa Fé Ry., at Los Vegas, New Mexico. The Willhouse system. 800 w. Loc Engng—May, 1900. No. 33886 C.

Tools.

Blacksmith Tools in a Small Railroad Shop. Illustrates and describes some of the labor-saving tools used in the Boston & Maine shops at Springfield, Mass. 800 w. Loc Engng—April, 1900. No. 33332 C.

Transfer Tables.

Transfer Tables. Illustrates and describes a novel design at the Portsmouth shops of the Seaboard Air Line. Also the table at Parsons, Kan., in the shops of Missouri, Kansas & Texas Ry. 800 w. Ry Age—April 20, 1900. No. 33762.

Water Supply.

Notes on Railway Water Supply. W. L. Derr. Considers the sources of supply, reservoirs, dams, wells, tanks, water cranes, pumps, pipes, etc. Also discussion and illustrations. 16500 w. N. Y. R R Club—March 15, 1900. No. 33788.

Some Peculiarities About Water. Editorial on the practical value of water selection and treatment for railways. 1500 w. Loc Engng—May, 1900. No. 33889 C.

Weed-Burning.

Weed-Burning Car, M., St. P. & S. St. M. Ry. Illustrated description of car and its operation and statement of cost. 1000 w. Ry & Engng Rev—April 21, 1900. No. 33790.

TRAFFIC.

Rates.

Compensation for Carrying Mails. J. Kruttschmitt. A letter criticising deductions drawn from testimony of Henry C. Adams, and discussing rates of railway mail. 2000 w. R R Gaz—April 20, 1900. No. 33753.

STREET AND ELECTRIC TRAMWAYS

Boston Elevated.

Some Construction Work of the Boston Elevated Railroad. Edgar M. Smith. Illustrates and describes some fine work under unusual conditions. 900 w. R R Gaz—April 20, 1900. No. 33759.

Compressed Air.

Traction by Compressed Air at Paris. Brief account of the lines and their operation. 1000 w. R R Gaz—April 6, 1900. No. 33459.

Electric Traction.

Schemes for the Application of Electric Traction to Railway Lines in Italy. Giovanni Georgi. Reports many roads now being equipped for electric traction. A system of trunk lines aggregating a length of 83 miles is being equipped, also mountain roads, and others. 1600 w. Elec Wld & Engr—April 21, 1900. No. 33764.

Electrolysis.

Electrolysis. E. H. Jenkins. Read before the Southwestern Gas, Electric, and Street Railway Assn. Considers the electrolytic action and the remedies. 3700 w. Am Gas Lgt Jour—April 23, 1900. No. 33767.

Expenses.

Working Expenses of Electric and Cable Railways. Tables of working expenses, receipts, etc., of the electric and cable railways of Great Britain. 1400 w. Tram & Ry Wld—April 5, 1900. No. 33731 A.

Goods Carrying.

Hauling Freight and Express Matter on Electric Railways. A discussion of this service, with suggestions of the latest and best practice, and a description of the methods on a number of roads. Ill. 5000 w. St Ry Rev—April 15, 1900. No. 33717 C.

Interurban.

Dayton, O., as an Interurban Railway Center. Brief account of the street railways of the city, with illustrated description of the interurban lines completed and under construction. 3800 w. St Ry Jour—April 7, 1900. No. 33464 D.

Oshkosh & Neenah Interurban Electric Ry. Illustrated detailed description of a 16 mile railway, which forms an important link in the proposed electric system from Chicago to Green Bay, Wis., a distance of 198 miles. 1900 w. Eng News—April 5, 1900. No. 33449.

The Detroit, Rochester, Romeo & Lake Orion Railway. Illustrated description of a recently completed electric railway, with information relating to its operation. 1800 w. St Ry Jour—April 7, 1900. No. 33465 D.

Japan.

The Nagoya, Japan, Electric Railway Company. T. Kogi. Brief descriptive account of the line. 800 w. Elec Wld & Engr—April 7, 1900. No. 33491.

Light Railways.

Light Railways in France. The first of a series of articles on the construction and working, considering only the practical points of completed lines. Ill. 3000 w. Engr, Lond—April 6, 1900. Serial. 1st part. No. 33710 A.

Locomotives.

New Electric Locomotives (Neuere Elektrische Lokomotiven). An illustrated description of some new electric locomotives doing heavy work in everyday practice. 1600 w. Zeitschr d Ver Deutscher Ing—March 24, 1900. No. 33556 D.

Methods.

Some Differences Between American and British City Transportation Methods. Edward E. Higgins. A statement of facts relating to street railway development in the two countries, with interesting comparison of results. 2800 w. St Ry Jour—April 7, 1900. No. 33471 D.

Mono-Rail.

Barmen Electric Suspension Railway. Illustrated description of double-railed line 8.3 miles in length, with 18 stations. 700 w. U. S. Cons Repts, No. 704—April 14, 1900. No. 33650 D.

Single Rail Suspension Railway at Barmen. Brief description with illustrations. 400 w. St Ry Rev—April 15, 1900. No. 33718 C.

The Langen Mono-Rail Suspended Railway at Elberfeld-Barmen. Editorial review of this system. Part first notes briefly the previous attempts. 1800 w. Engng—March 30. 1900. Serial. 1st part. No. 33616 A.

The Langen Suspended Railway. Translated description from the *Zeitschr. d Ver Deutscher Ing.*, of a remarkable railway system being built in Germany. Ill. 900 w. Eng News—April 5, 1900. No. 33448.

The Single-Rail Suspended Electric Railway between Barmen, Elberfeld and Vohwinkel (Die Elektrisch Betriebene Einschienige Schwebebahn Barmen-Elberfeld-Vohwinkel im Wupperthale). A description of this interesting overhead railway, with illustrations and plans. 800 w. Mitt d Ver f d Förd d Loc u Strassenbahnwesens—March, 1900. No. 33528 D.

Motor Suspensions.

Traction Motor Suspensions. Ernest Kilburn Scott. Part first illustrates and describes various forms of suspension used to avoid shock to the motor in electric traction. 1200 w. Elec Rev, Lond—April 13, 1900. Serial. 1st part. No. 33797 A.

Paris Conduit Road.

Electric Conduit Road in Paris (Unterirdische Stromzuführung für Strassenbahnen in Paris). Well illustrated description of this road, with many novel details of construction. 1500 w. Ill. Zeitschr f Klein u Strassenbahnen—March 16, 1900. No. 33576 C.

Polyphase.

Polyphase Transmission for Suburban Extensions. Discusses the advisability of installing polyphase apparatus and the proper type for long-distance extensions. 1600 w. St Ry Jour—April 7, 1900. No. 33470 D.

Power Station.

South Side Elevated Railroad Power House. Illustrated description of additions and improvements which make this one of the largest and best equipped electric power stations in Chicago. 2000 w. W Elect'n—April 14, 1900. No. 33674.

Rolling Stock.

New Rolling Stock for the Waterloo and City Railway. Illustrated description of motor cars for special requirements. 1300 w. Tram & Ry Wld—April 5, 1900. No. 33730 A.

Single Rail.

See Mono-Rail.

Subway.

The Extension of the Orleans Railroad from its Walhubert Station to the Quai d'Orsay in Paris (Ueber die Verlängerung der Orléansbahn von ihren Endbahnhofe Walhubert nach dem Quai d'Orsay in Paris). E. A. Ziffer. An illustrated account of the 2½ mile extension of the Orleans Railroad along the left bank of the Seine, in Paris. 5000 w. 1 plate. Mitt d Ver f d Förd d Loc-u Strassenbahnwesens—March, 1900. No. 33527 D.

Tests.

Electrical Tests of the Boston Elevated Railroad. An account of the tests made to determine what system for controlling the motors from one point was best adapted to the trains. 1600 w. R R Gaz—April 27, 1900. No. 33843.

Three-Phase.

Three-Phase Transmission on the Union Railroad, Providence, R. I. Burcham Harding. Describes the means taken by the road named to solve the problem of furnishing power upon economical terms for an extended line. Ill. 2000 w. St Ry Jour—April 7, 1900. No. 33467 D.

Underground Trolley.

Grounds on Underground Trolley Railway Systems. An unusual arrangement of the circuits is necessary to prevent short circuits, and the article describes the connections and operation of the switchboard. Ill. 3000 w. St Ry Jour—April 7, 1900. No. 33468 D.

Western Australia.

The Electric Tramway System of Perth. Illustrated detailed description of a road with interesting features. 1500 w. St Ry Jour—April 7, 1900. No. 33466 D.

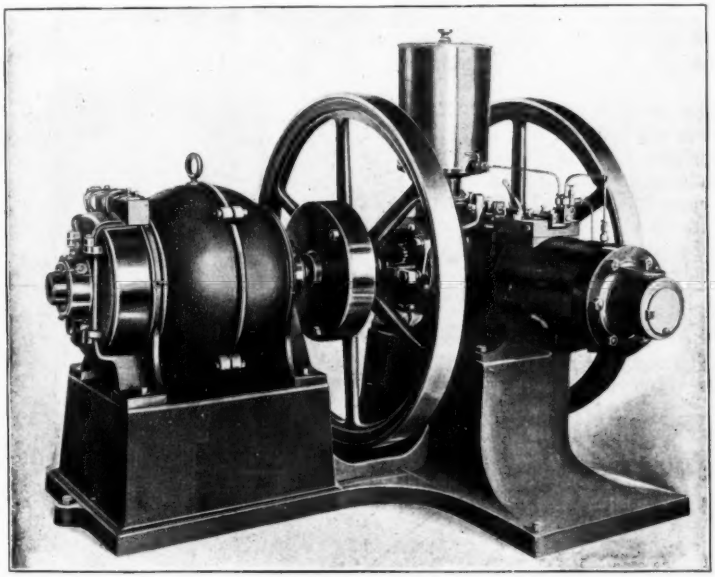
IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A Generator and Kerosene Engine.

THE successful operation of the kerosene engine in isolated electric lighting plants opens a large and useful field of application. Ease of management, economy, and safety recommend it as a very desirable motor in places where the steam engine fails for many reasons. It is true that in the modern steam engine as a power transmitting machine the chances for real improvement are very limited, but summing up all its necessaries as a prime mover, starting at the coal mine, or even at the coal yard, we have an entirely different picture before us. It is also true that the four cycle single cylinder gas engine, receiving, as it does at its best, only one power impulse for every two revolutions of its shaft, is by no means the ideal electric light engine.



The engine shown is of the two-cycle compression type, receiving a power impulse every revolution and provided with a sensitive governor maintaining the steady speed required for belted or direct coupled generators. The elastic coupling is of a new design. A small pump operated and controlled by the governor injects the precise amount of kerosene (ordinary lamp oil) directly in the motor cylinder, where it vaporizes and mixes with air for combustion.

The oil reservoir is placed at the side of the engine frame and at a certain point in each revolution a partial vacuum is created in the crank chamber and in the

cylinder. This is sufficient to draw the necessary oil up from the pipes and down past the sight holes which permit its proper regulation by the valves above. The oil for the crank drops into a groove on the top of the rod, whence it finds its way to the pin. These automatic oiling devices, it will be noted, are only operative when the engine is running, and when the engine is stopped they require no looking after. When the engine is to be stopped it is only necessary to throw up the little finger which regulates the oil supply.

Catalogues and blue prints will be sent to prospective buyers if application is made to August Mietz, 128-138 Mott street, New York.

The Erwin Steam Ram.

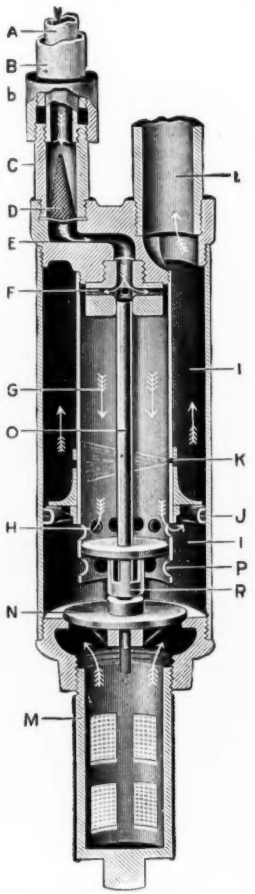
THE ram illustrated in section herewith is designed to lift water from tubular or other wells or from cisterns, lakes or streams, to a height of not more than sixty feet.

When the ram is at work, water is elevated by the alternate action of steam and atmospheric pressure. The steam having first driven the water from the ram is instantaneously condensed and a vacuum is formed. A volume of water is then driven into the ram by atmospheric pressure, and not only fills the vacuum chamber, but a large proportion passes on through the ram and into its discharge pipe. The steam and air thus co-act to make the discharge of water continuous. To the facts that a good portion of the work is done by the atmosphere and that friction is almost entirely eliminated, the high efficiency of the ram is largely due.

The ram is placed beneath the surface of the water in the well or other source of supply, and, before starting, water flows into it by gravity. When steam is turned on it passes through the steam pipe *a*, nipple *c*, conical screen *d*, the main steam port *e* and radial steam ports *f* into the cylinder *g*. The water is then forced downward through the openings *h* into the surrounding discharge chamber *i*, where it passes through the annular check valve *j* and out of the discharge pipe *l*.

When the steam reaches the lower end of the cylinder *g*, it is exhausted through the large openings *h* much faster than it is admitted through the steam ports *f*, is condensed in the surrounding discharge chamber *i*, and a partial vacuum is formed within the cylinder *g*. The vacuum is made more complete by a spray of water which then rushes inward from the discharge chamber *i* through the small opening *k*.

The instant a vacuum is created and condensation occurs the pressure of the atmosphere on the water outside of the ram forces water upward through the bottom strainer *m*. The main check valve *n* then rises and the valve rod *o*, which is rigidly attached to it, shuts off the steam at the upper end of the cylinder. A volume of



water under atmospheric pressure is at the same time forced upward through the discharge chamber and out into the discharge pipe. A portion of this water, however, passes through the openings *p*, forces up the float *r*, which moves freely on the valve rod *o*, and refills the cylinder.

The water under atmospheric pressure having then lost its momentum, the steam acting downward on the valve rod closes the main check valve, and through pressure exerted on the float again forces water out of the cylinder and through the discharge chamber and discharge pipe.

A covering pipe *b* surrounds the steam pipe for the distance it is submerged beneath water, to prevent condensation, and is received into the coupling *b*.

Further information may be had from the Penberthy Injector Co., Detroit, Mich.

Odorless Pumps.

THE excavating apparatus shown in operation in the accompanying engraving is designed for removing the contents of vaults, cesspools and similar receptacles, and consists of a powerful rock-shaft force-pump, hose, couplings and sealing caps, a tank-wagon supplied with the necessary fixtures, and a set of pitting barrels. By the use of this apparatus the work can be carried on during the regular working hours of the day without danger of being at all offensive. This, of itself, is a great advantage, much better and much more work being accomplished by day than by night. Designed for vaults as well as cesspools, the apparatus will remove by means of the pump all the material that could be dipped out, and under the pressure of a powerful suction all articles commonly found in a vault not too large to enter the full open end of the four-inch hose will pass through the pump and enter the tank wagon without clogging the valves. Rubbish too large to enter the hose must be hooked out of the vault and put in the pitting barrels, two of which are carried on each tank wagon under the driver's seat. When the contents of a vault is so hard that it will not close in around the suction hose, that is, so dry that ordinarily it could not be dipped out, then it must be softened by the addition of a few pails of water or shoveled out and carried off in the pitting barrels. Any vault or cesspool can be reached, as the hose can be placed over fences, through houses, into cellars or down alley-ways, and the contents may be pumped through it any distance to the tank-wagon.

The entire apparatus being air-tight when

in operation, there is no leakage or escape of gas from the time the material enters the open end of the suction hose until it is discharged from the tank-wagon at the dumping place. The gas driven from the tank by displacement at each stroke of the pump while loading, escapes through the vent pipe into the keg resting on the top of the tank. Here it is set free in a liquid disinfectant with which the keg is partially filled, and in passing through which, before entering the air, it becomes thoroughly deodorized and disinfected. This is an improvement over the system of passing the gas through burning charcoal, which has caused many explosions. This keg is removed after the tank is filled and the vent pipe sealed by means of a sealing cap attached by a chain to the coupling. By means of these caps the entire apparatus is rendered air-tight even when disconnected, so that it is odorless when passing through the streets from place to place. The apparatus is strong, durable and simple, and can be operated by anyone. It has been in constant operation for years in many cities and towns, and has the recommendation of many boards of health and contractors, and also of railroad, mining and other corporations who are using it.

Manufactured by the Odorless Excavating Co., Boston, Mass., who will send descriptive catalogue, etc., on request.

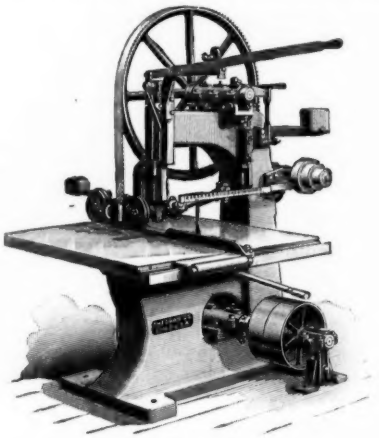
A New Band Rip Saw.

We illustrate a new automatic band rip saw, just brought out and placed on the market by the Egan Company, of Nos. 212 to 232 West Front street, Cincinnati, O.

This machine will do the work of several circular rip saws, and is much safer to operate, as there is no danger of the material being thrown back and striking the operator. The saw blade is very thin and removes only a slight kerf, which is quite an item in ripping fine lumber.

It will rip from one to nine inches thick with equal facility, and without changing blades. The adjustments are made very rapidly. The column is very heavy, cored, and perfectly free from vibration. The table is of ample size, always level, and has at the front a plainly stamped index.

The straining device is new and sensitive, and has a forward, backward and



side adjustment. The feed is very powerful, and both feeding-in and feeding-out rolls being placed close together short stock can be worked to advantage.

Where flooring and narrow stuff is made in large quantities this rip saw can be fitted with "live rolls," which will return material to operator for another cut, making it a great labor-saver.

The manufacturers will willingly furnish prices and full particulars on request, and will also forward their new illustrated catalogue free.